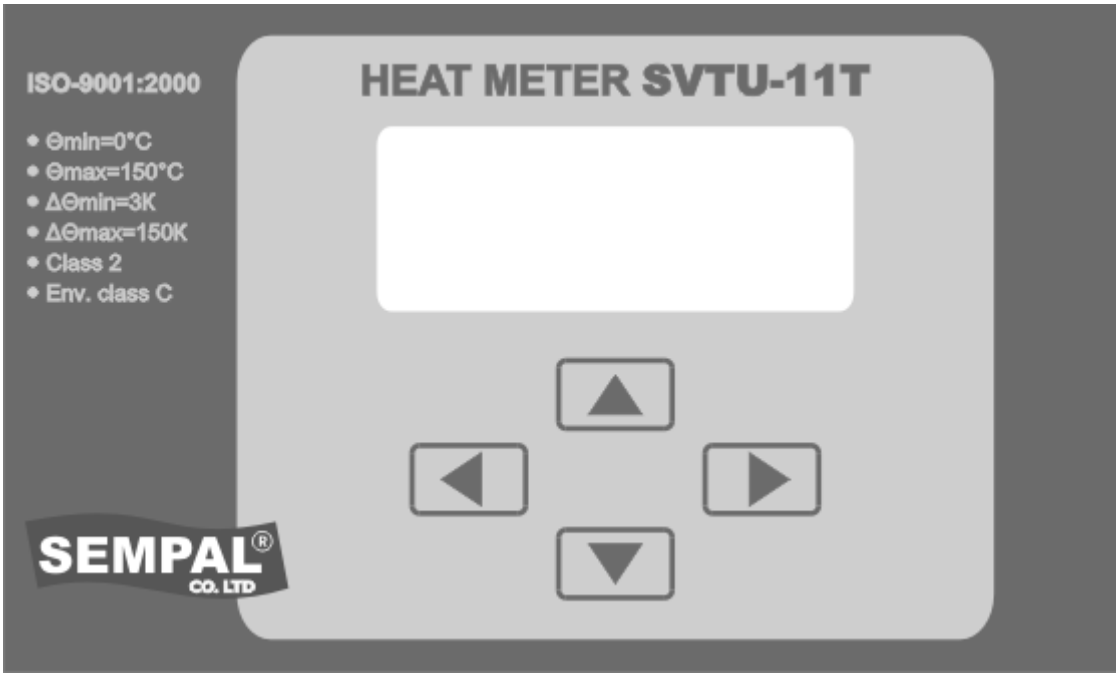
Heat meter SVTU-11T



Operating manual

SMP.407251.009 OM

(Part 1)

September 2010

Documentation:

Operating manual SMP407251.009 OM part 1.

Operating manual SMP.407251.009 OM part 2. Verification methodology.

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Abbreviation list

OM – operating manual.
FS – flow measurement section with ultrasonic flow sensors FlS.
RTD – resistive temperature detector.
RTD–S – platinum resistive temperature detector manufactured by SEMPAL Co.
NSC RTD – nominal static characteristic of RTD.
FlS – flow sensor.
TS – temperature sensor.
PT – pressure transducer.
DN – nominal diameter.
PN – nominal overpressure.
PC – personal computer.
RDU – data reader.
X – digit on the device display.

Information for customers

SVTU-11T heat meters (hereinafter referred to as meters) are complex measuring devices, which should undergo the starting-up and adjustment works by qualified personnel during commissioning.

Manufacturer's guarantees (48 months since shipment) extend on the meters which were put into operation by the specialized enterprises having corresponding credentials from company-manufacturer. More detailed information is resulted in section 16 ‘Manufacturer’s Guarantee’.

A recalibration interval is no more than 4 years.

The Quality System of SEMPAL is certificated under **ISO 9001:2000**.

If you have any questions about purchase, maintenance, operation and service of meters, contact us or our authorized regional representatives.

“SEMPAL Co LTD” contacts:

3 Kulibina Street, Kyiv, 03062 Ukraine
Phone/fax: (+38044) 239-2197, (+38044) 239-2198.
http://www.sempal.com

1 Preface

This operating manual (hereinafter referred to as OM) contains the following information: the assignment, field of application, performance capability and completeness, a principle of operation and a design, the method of installation and commissioning, the method of operation and maintenance service of meters.

While meters are in exploitation, it is necessary to be strictly guided by present OM.

Constantly working at functional enhancement, improvement of performance capability and increase of meter reliability, manufacturing company SEMPAL Co LTD reserves the right to itself to change the meter design without claiming it in present OM.

2 Assignment

2.1 SVTU-11T heat meters are intended for measurement of the consumed quantity of heat.

Meters also measure the volume, mass, temperature and overpressure of the heat-conveying liquid, water or fluids with solid particles of no more than 200 μm and residue mass of no more than 500 mg/l (hereinafter referred to as a heat-conveying liquid).

2.2 Meters depending on their configuration are applied for metering (including fiscal metering) of heat quantity (in closed or open heat supply systems) or water volume according to acting rules for the control of heat or water supply and consumption on industrial objects and objects of municipal services. Functional features of meters' configurations are given in 3.1.

3 Technical specifications

3.1 Meters can have next configurations:

- 2, 2/1, 2/2 – heat meters for closed heat systems;
- 4, 7 – heat meters for opened heat systems;
- 5 – heat meter for closed system with check water meter;
- 6 – heat meter for closed system and independent water meter.

3.2 Meters depending on their permissible error limits while measuring heat, volume, volumetric flow rate and mass of the heat-carrier are released in the following modifications: M1 and M2.

3.3 Meters of all modifications in accordance with environmental conditions meet class C of EN 1434 1. The meters can work under the following conditions:

- atmospheric pressure can vary from 84.0 up to 106.7 kPa;
- relative air humidity is up to 95 %.

3.4 Meters of configurations 2, 2/1, 5 and 6 meets the requirements of EN 1434.

3.5 The meter consists of the following functional units:

- flow measurement sections with ultrasonic flow sensors (FS);
- resistive temperature detectors (RTD);
- SVTU-11T calculator.

Highest possible number of measurement channels depending on meter's configuration is given in the table 3.1

Table 3.1

Channel	Number of channels
Ultrasonic flow measurement channel	2
Temperature measurement channel	3
Pressure measurement channel	2

Distinctive functional features of meter configurations and basic functional units are represented in the table 3.2. (meters' configurations in details are given in the appendix B)

Table 3.2

Distinctive structural and functional features	Configuration						
	2	2/1	2/2	4	5	6	7
Number of FS	1	1	1	2	2	2	2
Number of RTD	2	2	1	2	2	3	3
Measuring the temperature of the heat-conveying liquid in the return pipeline	+	+	–	+	+	+	+
Measuring the temperature of cold water	–	–	–	–	–	–	+
Measuring the volume of the heat-conveying liquid in the flow pipeline	+	–	+	+	+	+	+
Measuring the volume of the heat-conveying liquid in the return pipeline	–	+	–	+	+	–	+
Measuring the volume of water in the water supply system	–	–	–	–	–	+	–
Indicating heat-conveying liquid leak	–	–	–	+	+	–	+

Additionally the meter can have one or two overpressure transducers (further under the text - pressure transducers or PT), which are used for transformation of the water overpressure in a proportional electric signal with current from 4 up to 20 mA.

Metrological performance of pressure transducers PT fits to the individual order.

3.6 Meters indicate the results of measurements in SI unit system (MW, GJ, MPa). The heat power and heat quantity can be represented in CGS (GCal/h, GCal) unit system. Indication of measurement information is set in accordance with user's requirements.

3.7 Measured results are displayed on 2-sectional LCD.

The first section has 8-bit 7-segment indicator with special symbols. The measuring data are always displayed in this section.

The second section has one row (on the top of the indicator) for displaying text information. This section is switched on only during operation with keyboard.

The calculator indicates the following quantities:

- heat quantity, GJ (GCal);
- heat power, MW (GCal/hour);
- volume (mass) of the heat-conveying liquid or water, m^3 (ton);
- volumetric (mass) flow of the heat-conveying liquid or water, m^3/hour (ton/hour);
- heat-conveying liquid temperature, C;
- overpressure of the heat-conveying liquid, MPa;
- work time and non-work time, hour;
- current time (hours, minutes, seconds) and date.

3.8 The calculator provides storage of such archive data as measured values of heat quantiy and volume (mass) of the heat-conveying liquid (water), work time and non-work time and also average measured temperatures:

per hour - during 70 preceding days (hourly archive);

per day - within 1 preceding year (daily archive).

All stored information and measurable parameters can be read by standard interface RS-232C.

3.9 The number of display digits:

- for heat quantity, volume (mass) of the heat-conveying liquid is 8;
- for heat power, volumetric (mass) flow rate of the heat-conveying liquid is 5;
- for heat-conveying liquid temperature is 5;
- for overpressure of the heat-conveying liquid is 3;
- for work time, non-work time, and current time is 7.

3.10 The minimum bit value of digital display while indicating:

- heat quantity can vary from 10^{-7} up to 1 GJ (GCal);
- volume (mass) of the heat-conveying liquid can vary from 10^{-7} up to 1 m^3 (from 10^{-7} up to 1 ton);
- volumetric (mass) flow rate of the heat-conveying liquid can vary from 0.001 up to 0.1 m^3/hour (from 0.001 up to 0.1 ton/hour);
- heat power - from 0.001 up to 0.1 MW (GCal/hour);
- heat-conveying liquid temperature is 0.01 C;
- overpressure of the heat-conveying liquid is 0.01 MPa;
- work time and non-work time can vary from 10^{-5} to 1 hour;
- current time is 1 sec.

3.11 Meters provide measurements of heat quantity and volume (mass) of the heat-conveying liquid in ranges of volumetric flow rates and thermal power resulted in the table 3.3.

The table contains values of the lower limit of the flow rate (q_i), permanent flow rate (q_p) and the upper limit of the flow rate (q_s) for configurations 2, 2/1, 5, 6, and also values of the transitional flow rate (q_t) 2/2, 4, 7.

Table 3.3

Flow measurement section FS	Measurement range of the water, m^3/hour				Range of the thermal power, GJ /hour
	q_i	q_t	q_p	q_s	
FS-20	0.05	0.12	5	6.5	from $3.1 \cdot 10^{-4}$ to 8
FS-32	0.22	0.60	22	30	from $2.3 \cdot 10^{-4}$ to 30
FS-50	0.7	1.4	70	90	from $7.5 \cdot 10^{-3}$ to 92
FS-65	1.2	2.4	120	160	from 0.012 to 160
FS-80	1.8	3.6	180	230	from 0.018 to 235
FS-100	2.8	5.7	280	360	from 0.029 to 360
FS-125	4.5	8.8	450	580	from 0.046 to 570
FS-150	6.5	12.7	650	850	from 0.066 to 838

The lowest measurable volumetric flow rate is equal to $0.5 \cdot q_i$. If the flow rate is lower than q_i flow rate measurement error is not standardized.

3.12 The temperature of the heat-conveying liquid in flow and return pipelines can vary in a range from 0 up to 150vC.

The measurement range of secondary (not for heat calculation) temperatures can vary from -49 °C to 150 °C.

Number of channels for temperature measurement can vary from 1 to 3 in accordance with the order.

3.13 Meters provide measurement of heat quantity at temperature difference between the flow and return pipelines (ΔT) from 0 up to 150 C. The error of heat quantity measurement is standardized in temperature difference range. If temperature difference varies from 2.5 up to 150 °C the error of heat measurement is standardized in temperature range from 3 to 150 °C.

3.14 The maximal pressure measured by the meter is 4 MPa.

The range of the electric signals from pressure transducer varies from 4 up to 20 mA.

3.15 Meters have output signal for data communication by standard interface RS-232C.

3.16 Meters' power supply is realized by built-in lithium battery of 3.6V. Battery life-cycle is 5-6 years. Battery replacement can be done directly on-site without meter shutdown.

WARNING! Meter is delivered with switched off battery.

While delivering by air transport the battery should be switched off and removed from the meter.

3.17 Nominal diameters (DN), overall dimensions and weight of FS, and also length and weight of RTD depending on their type are shown in tables **Ошибка! Источник ссылки не найден.**, **Ошибка! Источник ссылки не найден.** and on **Ошибка! Источник ссылки не найден.**.

The notice

1 It is possible to increase the total length of FS due to the length of straight sections before and after places for installation of ultrasonic flow sensors.

2 DN is the designation of nominal bore, which numerical value **is approximately equal** to internal diameter **of attached** pipe sections.

3.18 For configurations 2/2 in all modifications heat meter should meet to accuracy class 2.5.

For configurations 4, 7 in all modifications heat meter should meet to accuracy class 4.

For configurations 2, 2/1, 5, 6 in modification M1 heat meter should meet accuracy class 1, in modification M2 heat meter should meet to accuracy class 2 in accordance with EN 1434.

3.19 Permissible error limits for configuration 2/2 in modification M1 while measuring the quantity of heat are:

- ± 1.5 % (± 4 %) while ΔΘ varies from 20 °C (included) to 150 °C (included);
- ± 2 % (± 4 %) ─ while ΔΘ varies from 10 °C (included) to 20 °C;
- ± 5 % (± 6 %) ─ while ΔΘ varies from 3 °C (included) to 10 °C.

Permissible error limits for configuration 2/2 in modification M2 while measuring the quantity of heat are:

– ± 2.5 % (± 4 %) ─ while ΔΘ varies from 20 °C (included) to 150 °C (included);

– ± 3 % (± 4 %) ─ while ΔΘ varies from 10 °C (included) to 20 °C;

– ± 5.5 % (± 6 %) ─ while ΔΘ varies from 3 °C (included) to 10 °C.

Limits of heat quantity measurement error while flow rate of heat-conveying liquid varies from q_{min} (included) up to q_t are shown in the brackets.

3.20 Permissible error limits for configuration 4, 7 in modification M1 while measuring the quantity of heat are:

– ± 2.5 % (± 4.5 %) - while ΔΘ varies from 20 °C (included) to 150 °C (included);

– ± 3.5 % (± 5.5 %) - while ΔΘ varies from 10 °C (included) to 20 °C;

– ± 5.5 % (± 7.5 %) - while ΔΘ varies from 3 °C (included) to 10 °C.

3.21 Permissible error limits for configuration 4, 7 in modification M2 while measuring the quantity of heat are:

– ± 4 % (± 6 %) - while ΔΘ varies from 20 °C (included) to 150 °C (included);

– ± 5 % (± 7 %) - while ΔΘ varies from 10 °C (included) to 20 °C;

– ± 6 % (± 8 %) - while ΔΘ varies from 3 °C (included) to 10 °C.

3.22 Permissible error limits for configuration 2, 2/1, 5, 6 while measuring the quantity of heat are:

– for accuracy class 1 – $\pm (2+0{,}01 \cdot q_p/q + 4 \cdot 3/\Delta\Theta)$ %;

– for accuracy class 2 – $\pm (3+0{,}02 \cdot q_p/q + 4 \cdot 3/\Delta\Theta)$ %;

where ΔΘ is measured temperature difference of heat-conveying liquid in the flow and return pipes, °C.

3.23 Permissible flow rate measurement error limits for configurations 2, 2/1, 5, 6 while measuring volume and mass of heat-conveying liquid should be:

– $\pm (1+0.01 \cdot q_p/q)$ % for accuracy class 1;

– $\pm (2+0.02 \cdot q_p/q)$ % for accuracy class 2;

where q is measured flow rate value, m^3/h.

3.24 Limits of permissible absolute error for heat meters while measuring a heat-conveying liquid temperature are $\pm(0.2+0.002 \cdot \Theta)$ °C.

Limits of permissible absolute error for heat meters of configurations 2/2, 4, 7 in all modifications while measuring a temperature difference are $\pm (0.1+0.001 \cdot \Delta\Theta)$ K, where ΔΘ is numerical value of temperature difference, °C.

3.25 Limits of pressure measurement error:

– ± 0.5 % when PT from meter's set are used;

– $\pm \sqrt{0.2^2 + \delta_{PT}^2}$ when customer's PT are used ,

where δ_{PT} is permissible error limit of customer's PT.

Specific coefficients of PT curve are entered into calculator's memory.

3.26 The calculator has two passive pulse outputs. Pulse outputs meet to class OD in accordance with EN 1434.

Maximum switched voltage should be no more than 10 V while switched current is no more than 10 mA.

Maximum pulse-repetition frequency is 100 Hz while pulse duration is 4 ms ± 0.5 ms.

Pulse settings (set by user) are from 1 to 9999999 pulse/unit. Where «unit» is unit of measure for transformed physical quantity. The user can select from the following physical quantities: volume (pulse/m^3), mass (pulse/ton), heat quantity (pulse/GJ).

3.27 Limits of absolute meter error while measuring the work time and non-work time are ± 1 minute per 24 hours.

3.28 Measurement information about heat quantity, heat-conveying liquid volume and, also, work time and non-work time is stored in nonvolatile meter's memory within 8 years with power off.

3.29 The maximal heat-conveying liquid overpressure inside flow measurement section is 1.6 MPa (16 kgf/cm^2).

3.30 Protection class of calculator enclosure is IP 65.

3.31 Calculator mass is no more than 750 gram.

3.32 Calculator overall dimensions don't exceed 170×110×35 mm, and with device connector and wall mounting accessories – 250×110×60 mm (see Appendix **B**).

3.33 Nominal diameters (DN), overall dimensions, and FS weight, as well as length and weight of RTD depending on their type are shown in tables 3.6, 3.7 and in figures 3.1, 9.9.

3.34 Mean error-free work time for meters is not less than 50 000 hours, for calculators – 100 000 hours.

3.35 Total average meter life cycle is not less than 12 years.

Table 3.4 Types, dimensions and weight of RTD-T

RTD types	Length in mm, no more than		Weight, kg, no more than
	L_{RTD}	L	
4	58	86	0.06
2	80	108	0.08
3	150	178	0.1
5	310	346	0.25
6	360	396	0.3
The notice. Select the type depending on DN according to instructions mentioned in tables 9.2, 9.3 and in figures 9.8, 9.9, 9.10			

Mounting dimensions for RTD of types 2, 3, 4 are given in Figure 3.1.

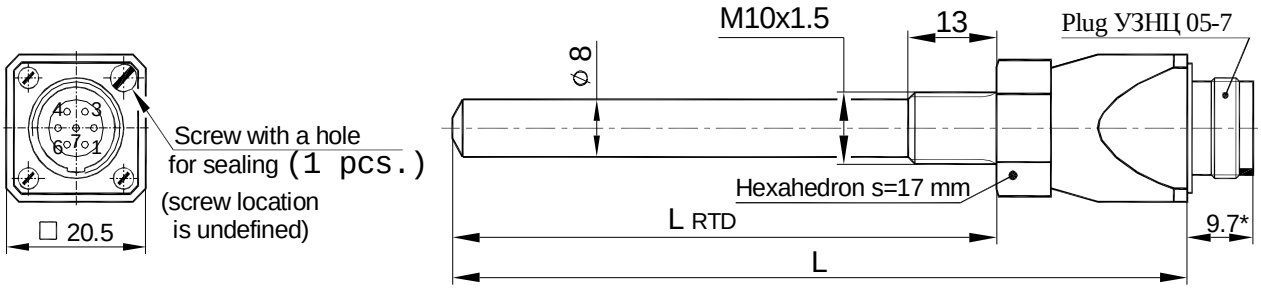


Figure 3.1

Table 3.5 Overall and connecting dimensions, FS weight (for drawings see Appendix К)

FS	Nominal diameter, mm	Nominal overall and connecting dimensions of FS, mm						n, pcs.	Weight, kg, not more than (no fasts)	
	DN	L	D_f	H	D	d	d1		For FS	For flanges
РУ-20	20	270	Pipe. G1”	90	∅20	-	-	-	2.3	2.7*
РУ-32	32	180	M48x2	79	∅32	-	-	-	1.8	2.6*
РУ-50	50	180	∅122	-	∅50	∅102	∅11	6	4.8	2.2
РУ-65	65	200	∅144	-	∅63	∅124			5.8	2.9
РУ-80	80	210	∅155	-	∅79	∅135			6.9	3.2
РУ-100	100	230	∅184	230	∅(95…105)**	∅164		8	7.8	4.1
РУ-125	125	265	∅210	270	∅(119…131)**	∅190		10	10.6	5.2
РУ-150	150	315	∅236	296	∅(143…156)**	∅212	∅13		20.0	7.7

*Weight of straight sections with screws.
** Nominal bores D are multiple of 1mm

4 Package contents

4.1 The meter complete delivery set is represented in the table 4.1.

Table 4.1

Name and reference designation	Marking	Number	Additional information
SVTU-11T heat meter , including:	SMP.407251.009	1 pcs.	Configuration and completeness in accordance with the order (see items 1…8)
1 SVTU-11T Calculator	SMP. 408843.011	1 pcs.	While in delivery the battery is switched off
2 Flow measurement section (FS) with screws for flow sensors fixing (no screws in complete set for FS-20 … FS-150)	Marking for FS-20 to FS-150 included – in the table 4.2	See additional information	Number, configuration and dimension-type in accordance with the order (see Appendixes А and tables 4.2, 4.3)
3 Ultrasonic flow sensor (FlS) with fluoroplastic seal ring (FlS for FS-20 aren't delivered separately. Flow measurement section FS-20 is delivered together with FlS)	SMP.407151.009 (for FS-32…80); SMP.407151.011-01 (for FS-100);	See additional information	Number of FlS for one FS is defined by number of places for their installation in accordance with the order (see table 4.2)
4 Resistive temperature detector RTD–T	SMP.405212.003 - 01 (–02, –03)	See additional information	Number and configuration (type) in accordance with the order
5 Overpressure sensors (PS)	-	See additional information	Number, type and completeness according to the order. Complete set can include elements indicated in Appendix Ж
6 Connection cable (device cable)	SMP.685694.029	1 pcs.	Number of communication lines and their length according to the order (see Appendixes А)
7 SVTU-11T. Heat meter Operating manual	SMP.407251.009 OM	1 pcs.	
8 Packaging (set)	SMP.323248.002	1 set	
9 Modem	Type is selected in coordination with the customer		In coordination with the customer while ordering the MDM unit
10 Data Reader			Special order

Name and reference designation	Marking	Number	Additional information
11 Adapter module MC-1			Special order
12 Protection enclosure	SMP.301538.006		Special order
13 SVTU-11T heat meters. Operating manual. Part 2 «Verification methodology»	SMP. 407251.009 OM2	1 pcs.	Special order
14 Reserve belongings	SMP.305653.001		Completeness and number is ordered

Notes

1 FS is delivered with flanges and fasteners see table 4.3.

2 FS can be delivered with straight pipe sections (length is up to 25 internal diameters of the pipeline). The specified sections can be welded to flanges if necessary.

While ordering straight pipe sections all necessary materials for installation (for example, electrodes for welding, paint, sealing materials, etc.) can be delivered additionally.

3 Reserve belongings can include elements listed in the table 4.1, table 4.3, enclosure of the SVTU-11T calculator, a board of the SVTU-11T calculator as it was ordered.

4 Data Reader can be delivered as a pocket PC, laptop or as a dedicated device RDU-02. Model of pocket PC or laptop is selected by customer.

Designation and basic parameters of FS in complete set are indicated in the table 4.2.

(For outline drawing of FS see Appendix **И**)

Table 4.2

FS	DN, mm	Marking on FS		Number of places for flow sensors	Marking
		Nominal bore	Nominal pressure		
Single beam flow measurement section					
FS -20	20	DN 20	PN 16	-	FS -20
FS -32	32	DN 32		2	FS -32
FS -50	50	DN 50			FS -50
FS -65	65	DN 65			FS -65
FS -80	80	DN 80			FS -80
FS -100	100	DN 100			FS -100
РУ-125	125	DN 125			FS -125
РУ-150	150	DN 150			FS -150

Another componentry included in delivery set in accordance with the obligatory or additional order are listed in the table 4.3.

4.2 Meter's configuration, FS type, connecting cables, number of communications channels and their length are specified while ordering. The format of meter's marking is given in Appendix **А**.

Description of design features for FS and also drawings, mounting dimensions are resulted in Appendix **К**.

Warning!!!

Identification of FS standard size is provided by marking of nominal diameter DN on FS body.

Thus numerical value in FS reference designation meets to a numerical value in a designation of a nominal diameter DN (see table 4.2).

Example:

– marking "**DN 32**" put on the flow measurement section with reference designation FS-32. Next element of marking "**PN 16**" means that this flow measurement section is intended for use in heat- or water-supply systems with overpressure 1.6 MPa (16 kgf/cm^2);

Table 4.3 Componentry included in delivery set

#	Name	Marking	Assignment	Number	Set of delivery	
					obligatory	by the order
1	Pipe nipple	SMP.752291.001	Connection of FS-20 with straight pipe section	2 pcs. for 1 FS	+	
2	Pipe nipple	SMP.302661.002	Connection of FS -32p with straight pipe section		+	
3	Sleeve nut	SMP.758422.006	Mounting of FS-20		+	
4	Sleeve nut	SMP.758422.001	Mounting of FS -32		+	
5	Flange	SMP.711154.013-01, 013-03, 013-05 (in accordance with DN of FS)	Mounting of FS -50…80		+	
6	Flange	SMP.711154.004-03 … 004-05 (in accordance with DN of FS)	Mounting of FS -100		+	
7	Gasket (paronite)	SMP.754152.013	Sealing of flanges FS-20	2 pcs. for	+	

#	Name	Marking	Assignment	Number	Set of delivery	
					obligatory	by the order
8	Gasket (paronite)	SMP.754152.009	Sealing of flanges FS-32	1 FS	+	
9	Gasket (paronite)	SMP.754152.007…007-16	Sealing of flanges FS-50…100		+	
10	RTD pocket (L_{RTD}=58mm, type 4)	SMP.753137.002-03	Protection of the RTD from hydraulic impacts	1 pcs. for 1RTD		+
11	RTD pocket (L_{RTD}=80mm, type 2)	SMP.753137.002-01				+
12	RTD pocket (L_{RTD}=150mm, type 3)	SMP.302634.002				+
13	Sealing ring (fluoroplastic)	SMP.754176.003	Sealing of RTD for types 2, 3, 4		+	
14	Sealing ring (fluoroplastic)	SMP.754176.003-01	Sealing of RTD bush for types 2, 3, 4	1 pcs. for 1 sleeve		+
15	Bush (for angle α=45º)	SMP.723144.007	Installation of RTD for types 2, 3, 4 without bush	1 pcs. for 1RTD	+	
16	Bush (for angle α=60º)	SMP.723144.008			+	
17	Bush (for angle α=90º)	SMP.723144.009			+	
18	Bush (for angle α=45º)	SMP.723144.007-01	Installation of RTD bush for types 2, 3, 4	1 pcs. for 1 sleeve		+
19	Bush (for angle α=60º)	SMP.723144.008-01				+
20	Bush (for angle α=90º)	SMP.723144.009-01				+
21	Connecting pipe (G 1/2" x 1/4")	SMP.716161.004	For installation of pressure sensor	1 pcs. for 1 PS	+	
22	Gasket (paronite or fluoroplastic)	SMP.754156.010	For PS		+	
23	Gasket (paronite or fluoroplastic)	SMP.754156.010-01	For threaded		+	
24	Gasket	SMP.754156.001	Sealing of device connector	1 pcs.	+	
25	AB 1000WLV Set: - crampon	n/a	Mounting of the Calculator	2 pcs.	+	
	- corbel			2 pcs.	+	
	- washer «star»			2 pcs.	+	
	- screw M4 (hex)			2 pcs.	+	
Fixings: (thread diameter d and bolt length L fit to holes in flanges and total flange thickness)						
26	- screw M3x10	Ukrainian State Standard GOST 17473-80	Mounting of device connector	4 pcs.	+	
27	- washer 3	Ukrainian State Standard GOST 10450-78 or 11371-78		4 pcs.	+	
28	Bolts A. (dxL).88.35.019	Ukrainian State Standard GOST 7805-70	FS-50…100	In accordance with total number of holes in FS flanges (see table 3.3)	+	
29	Nuts A. (d). 9.35.019	Ukrainian State Standard GOST 5927-70			+	

5 Structure and functioning of meters

5.1 Heat meter provides measurement of heat quantity measuring volumes, temperatures and pressures of heat-conveying liquid in flow and return pipes.

5.2 The principle of flow measurement of heat-conveying liquid is ultrasonic time-of-flight. The time for the sound to travel between a transmitter and a receiver is measured. The time difference is proportional to the average fluid velocity and flow rate correspondingly. The integrated momentary flow rate values give the information about heat-conveying liquid volume which has passed through FS. The heat-conveying liquid mass is calculated as a function of volume and density of the flow depending on its temperature.

5.3 Heat-conveying liquid temperature is measured by platinum resistive temperature detectors installed in appropriate pipes.

5.4 Flow rate measuring process is continuous. Flow rate measurement is occurred a few times per second and obtained data are stored. Reading of stored data is occurred 1 time per second to calculate the quantity of heat.

Measurement cycle for temperature and pressure is one time in 10 sec.

Every measurement cycle lasts for 1 sec and includes measurement of heat-conveying liquid parameters, as well as self-diagnostics of the meter.

5.5 Heat meters can be represented in the following configurations (see Appendix **Б**):

– 2 (or 2/0) – heat meter in a closed district heating system with measurement of temperatures in the flow and return pipes. Flow meter is installed in the flow pipe;

– 2/1 – heat meter in a closed district heating system with measurement of temperatures in the flow and return pipes. Flow meter is installed in the return pipe;

– 2/2 – heat meter in a closed district heating system with measurement of temperature in the flow pipe. The return pipe temperature is programmed. Flow meter is installed in the flow pipe;

– 4 – heat meter in an open district heating system. The cold water temperature is programmed;

– 5 – heat meter in a closed district heating system with a control water meter on the return pipeline. Water leak as a difference between flow rates in the flow and return pipes is indicated;

– 6 – heat meter in a closed district heating system and an independent water meter;

– 7 - heat meter in an open district heating system with a cold water pipeline. Cold water temperature is measured.

Next denotations are used in the expressions given below:

Q – heat energy (J);

H – specific enthalpy (J/kg);

q_m – mass flow rate (kg/hour);

t – time (h).

The specific enthalpy is a temperature and pressure function, therefore for increase of enthalpy calculation accuracy during meter commissioning the overpressure values for corresponding pipelines are entered in meter memory. In the case of malfunction of PS the heat quantity calculation is provided based on programmed pressure value.

When pressure sensors are included for delivery the user can set the pressure value obtained from one of the available PS to calculate a heat quantity.

Entered (measured) pressure values are displayed in records as P1, P2 and Pcold. So if the meter doesn't include PS then entered values are recorded. If the meter is completed with PS, then measured values are recorded.

For configuration 4 the entered (not measured) cold temperature value is considered. Thus any change of cold water temperature is fixed in the event journal.

Entered value of cold water temperature can be changed from 0 up to 25.5 C with 0.1 ºC resolution. *If the value 0.0 ºC was entered the specific enthalpy value is identically equated to 0.*

Bringing into service meter configurations with the entered cold water temperature it is necessary to consider, that the heat quantity measured by a heat meter mismatches heat quantity which has been produced by the heat supplier. It is because the entered temperature

of cold water is not equal to the valid temperature of cold water which changes in time. In this case at settlement with the heat supplier it can be demanded (depending on requirements of settlement rules between the supplier and the consumer) a corrective procedure according to applicable normative documents.

Schemes for sensors connection in different configurations are represented in Appendix **Б**.

5.5.1 **Closed heat supply system** (heat meter configurations **2, 5, 6**). Heat quantity calculation is carried out under formula:

$$Q = \int_t q_m \cdot (H_1 - H_2) \cdot dt \qquad (5.1)$$

where q_m is heat-conveying liquid flow rate in the flow pipeline, kg/hour;
H_1 and H_2 are heat-conveying liquid specific enthalpies in flow and return pipes of the heat-exchange system, correspondingly, Joule/kg;
t is time, hour.

5.5.2 **Open heat supply system** (heat meter configurations 4 and 7):

$$Q = \int_t q_{m1} \cdot H_1 \cdot dt - \int_t q_{m2} \cdot H_2 \cdot dt - \int_t (q_{m1} - q_{m2}) \cdot H_{cold} \cdot dt \qquad (5.2)$$

where q_{m1} and qm2 are heat-conveying liquid mass flow rates in the flow and return pipelines, correspondingly, kg/hour;
H1, H2 are heat- conveying liquid enthalpies in the flow and return pipelines, correspondingly, Joule/kg;
Hcold is cold water specific enthalpy.

In 4th configuration we don't measure cold water temperature, but enter it programmatically (this temperature is entered by user).

Meters of configurations 4 and 7 measure heat-conveying liquid flow rate in the flow and return pipelines and ***calculate*** flow rate difference ΔG_M. Meters of configurations 4 and 7 ***don't measure*** water leaks, water leak is ***calculated*** as flow rate difference in the flow and return pipelines.

5.6 The meter carries out calculation, recording in memory (archive) and further printout of average temperature values for heat quantity calculation per time t_0-t_1 as average-weighted values found under following formula:

$$\overline{\Theta}_{\int} = \frac{\int_{t_0}^{t_1} \Theta(t) \cdot q_m(t) \cdot dt}{\int_{t_0}^{t_1} q_m(t) \cdot dt} \qquad (5.10)$$

where $\Theta(t)$ is momentary (current) measured temperature values;
$q_m(t)$ is momentary (current) measured values of mass flow rate of the heat-conveying liquid (water).

For discrete in time measurements provided by meter every 1-2 sec, the following formula is valid:

$$\Theta_{W.AV} = \frac{\sum_i \Theta_i \cdot q_{mi}}{\sum_i q_{mi}} \qquad (5.11)$$

where Θ_{mi} and q_{mi} are the temperature and mass flow rate of heat-conveying liquid, correspondingly for i^{th} measurement.

In case of no flow rate of heat-conveying-liquid the temperature is calculated as arithmetic mean value for all measurable temperature values for specific time.

For temperatures, which are not taken in calculation of heat quantity, the arithmetic mean temperature value is calculated.

5.7 The meter carries out flow measurement in the range from $0.5q_i$ (q_{min}) till q_s (see table 3.3).

For all types of FS measurement errors are provided in a range [q_i (q_{min}); q_s], but in subranges [$0.5q_i$ (q_{min}); q_i (q_{min})[the mentioned measurement errors are not standardized, however device working capacity is kept, and the heat-conveying liquid mass storing and heat calculation are carried out.

While measuring instantaneous flow rate values $q < 0.5\ q_i$ (q_{min}) the device indicates 'zero-flow' message and mass storing $m=q\cdot\rho$ isn't carried out.

5.8 Measurement of the heat-conveying liquid (water) overpressure is carried out by calculator while measuring the current of electric signal from the pressure transducer. Overpressure values P_{op} (MPa), measured and displayed by the calculator, and current I_{in} (mA) on an input of pressure measuring channel (on the calculator input) are connected by a following ratio:

5.9
$$P_{op} = (I_{meas} - I_1) \cdot \frac{(P_2 - P_1)}{(I_2 - I_1)} + P_1 \qquad (5.12)$$

where P_1 and P_2 are pressure values in two points of pressure transducer characteristic (for example, minimal and maximum pressure);

I1 and I2 are correspondingly currents on the PT outputs in the above specified points;

U_{meas} is value of measured current on the output of PT.

5.10 While measuring time parameters the meter carries out measurement of following quantities: time of correct work (running or work time), time of incorrect work (time of errors), power on time, power off time (non-work or idle time), and also displays current (taking into account daylight saving) time.

Time of correct work (running time Trun or work time) – device operating time (power on, no error messages). Time of correct work on 1-st and 2-nd channels is displayed on the water meter indicator in a mode **«Indication of additional parameters»** (see item 11.2.2, table 11.3 of this Manual, and also Appendix D).

Time of incorrect work (time of errors Terr) – device operating time (power on, there are error messages). **Terr** values are presented in printouts of stored data archives and error archives.

Power on time Tpower – total time when the device power supply voltage is on. It is indicated on the meter display in a mode **"Indication of additional parameters"** and also is presented in a daily archive printout.

Power off time (idle time Tidle or non-work time) – total time when the device power supply voltage is off. It is displayed on the meter indicator in a mode **« Indication of additional parameters»,** and also included in daily report.

Current date/time – current time (taking into account daylight saving). It is indicated on the meter display in a mode **"Indication of additional parameters".** Automatic switch to daylight saving time mode can be on/off.

Measurement, indication and registration of above-listed parameters are carried out in hours. In figure 5.1 the timing sheet is represented. It explains how time of correct work **Trun** and time of non-working condition **Tnw** for accounting period **Tacc** are resulted. During **Trun** authentic measurement of all parameters was made**,** during **Tnw** there is no registration of any parameter or there is no power supply voltage (battery disconnected).

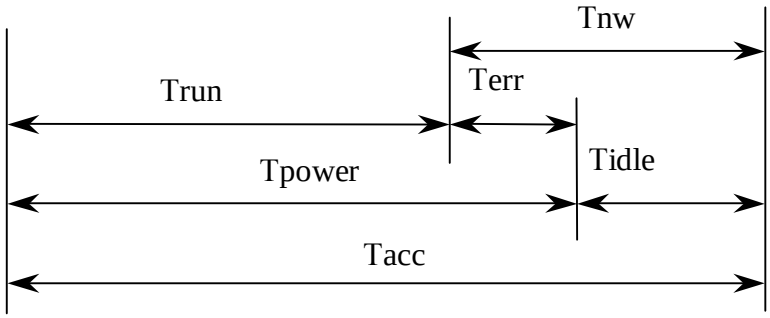


Fig. 5.1

5.11 To connect to external devices RS-232C is applied. RxD, TxD, DTR, RTS lines are used.

5.12 Meters have a few separate modules which connected between themselves. They are calculator, temperature sensors, flow measurement section with ultrasonic flow sensors, pressure transducers.

5.12.1 The calculator housing has four control buttons, the digital display, slots for connecting cables.

Heat meter control buttons are described in chapter 11 and Appendix **Г**.

5.12.2 Heat meter's digital display has two sections. The first one contains a 8-bit 7-segment indicator and specific symbols. In this section the measuring data and units are displayed. The second section is a row for displaying text information. It is arranged in the upper part of indicator. This section is lightening if the user needs to see additional information and complete some kind of actions in device menu.

The basic working mode of the meter is displaying measuring data from main menu. At this time the second section is switched off.

5.12.3 FS is a spool piece with flanges and bushes for mounting ultrasonic flow sensors. FS sizes (linear and angular) have rigid tolerances to achieve required measuring accuracy and stability of operation. Sizes are resulted in the table 4.2, and also in the Appendix **И**.

5.12.4 RTD are installed in pipelines in special thermometer pockets or bushes (in accordance with the order) on the flow and return pipes of heat exchange system.

5.12.5 The length of connecting cables is determined according to a lay-out of meter components and can be within the limits:

- from 2 to 10 m (max 30 m) for ultrasonic flow sensors,
- from 2 to 10 m (max 30 m) for temperature sensors,
- from 2 to 10 m (max 30 m) for pressure sensors,
- from 2 to 30 m (max 50 m) for RS-232 interface.

Extending cable length up values in squares possible only by additional agreement.

6 Marking and sealing

6.1 Meter marking on the calculator contains the following data:

- name and reference designation of meters;
- trade mark of the manufacturer ;
- accuracy class (meter's modifications M1 or M2);
- environmental class;
- limits of temperature measurement range (Θ_{min} and Θ_{max});
- limits of measurable temperature difference ($\Delta\Theta_{min}$ and $\Delta\Theta_{max}$);
- serial number;
- date of manufacture (two last digits of a year, printed before works number).

On the indicating device of a heat meter:

- limiting flow rate values;
- installation place for flow measurement section – in the flow or return pipelines.

On the flow measurement section:

- nominal bore;
- flow direction arrow;
- maximum operating pressure.

Serial numbers of RTD and FS are put on their bodies.

6.2 FS marking contains nominal diameter DN and maximal operational overpressure value PN.

6.3 Meter components are sealed up to prevent a non-authorized access to adjustment of meter's readings.

6.4 The calculator is sealed up by two mastic seals. Seals are put on fixing screws on lateral covers. For mastic fixing sealing cups are provided under screw heads.

For realization of additional sealing by means of a lead seal, the screws with holes in heads on lateral covers are stipulated. On customer's demand the replacement of these screws by additional sealing cups is possible.

Marking of connecting cables are put on labels, located near corresponding connectors.

7 Packing and marking

7.1 Marking of transport container has specific instructions "CAUTIOUSLY FRAGILE", “PROTECT FROM MOISTURE”, "TOP".

7.2 Meter components are packed into the boxes in accordance with drawings of manufacturer.

In coordination with the customer FS delivery without transport container or in customer’s container is possible.

8 Safety precautions

8.1 Meter’s design meets to safety precautions in accordance with State Standard GOST 12.2.003.

8.2 If meter runs together with equipment of 220V power supply, then safety requirements for work with electrical installations (voltage up to 1000V) should be considered.

9 Installation

9.1 Unpacking and degreasing

Unpacking and degreasing of meters are carried out after their being indoors within 2 hours, while ambient temperature varies from 10 up to 30 C and relative humidity is no more than 80 %.

To make unpacking, please follow the instructions:

- open packing boxes;
- take a package with the calculator and operational documentation;
- check up completeness of meters in accordance with the order;
- take meter components from packing boxes, make an external survey and be convinced that there is no mechanical damages, coating infringements and isolation of connecting cables.

Battery installation into calculator should be done as follows:

- Screw off four screws, which fix a cover of battery module;
- connect a battery to a calculator board in accordance with the figure 12.1;
- carefully put a battery into a module, battery cable should be located right inside a module;
- close a cover of module and tighten it up by screws.

Wait for appearance of a notice “battery” on the indicator.

Set current time. Procedure to set time is described in Appendix **Г**.

9.2 Installation requirements

9.2.1 Installation of meter components is carried out in accordance with chosen configuration, necessity of application of the additional equipment, and also parameters of district heating system.

Schematic circuits for meter installation depending on its configuration are given in Appendix Б.

9.2.2 Climatic conditions in a room, where meter components are installed should be as follows:

1) In a place for FS and RTD installation:

- ambient temperature can vary from –40 °C up to +70 °C;
- ambient humidity is up to 95 %, while temperature is 35 °C;

2) In a place for calculator installation:

- ambient temperature can vary from 5 °C up to 55 C;
- ambient humidity is up to 93 % while temperature is 25 °C.

Climatic conditions in a place for installation of the additional equipment should meet the conditions specified in the operational documentation for this equipment.

9.2.3 Protection of places for FS and RTD installation from direct ingress of moisture, dirt, oils and aggressive liquids should be provided.

The content of acid and alkali fume in air of premises, where meter components are installed, should be within the limits of sanitary rules.

For outdoor FS installation it is recommended to provide protection (canopy) against direct ingress of atmospheric precipitates on ultrasonic flow sensors.

FS installation in places with possible short-term water flooding is allowed while observing following protection measures for FS and entrance cables:

– the lining of cables should be made in protective waterproof pipes, which are resistant to influence of an environment (including the increased temperature);

– area for connection of protective pipes to ultrasonic flow sensors or RTD should be protected from water influence by means of tight clutch, profile sealants or other ways recommended by the manufacturer of protective pipes.

9.3 Requirements to FS installation and arrangement

FS is installed into a pipeline.

FS installation place should be as much as possible moved away from sources of vibrations, jolting, electromagnetic interferences (electromotors, pumps, compressors, etc.). No electric voltage relative to a protective contour of grounding in the place, where FS should be installed.

The distance between flow measurement section and an installation area for the calculator should be minimal and not exceed 10 m. It is possible to increase the distance up to 20 m by agreement with the manufacturer.

In all cases it is necessary to provide full filling of flow measurement section with water otherwise meters stop functioning, and malfunction (see chapter 13 of OM) would be diagnosed.

Flow measurement sections can be installed in vertical position, however submission of the heat-conveying liquid thus should be carried out in a direction bottom-top for providing FS with water filling.

Heat meter operation in special conditions (incomplete filling of FS with the heat-conveying liquid or polluted heat-conveying liquid) determines its location as resulted in figure 9.1. In this case complete water filling of FS is guaranteed. The most polluted pipeline section appears in a place below FS.

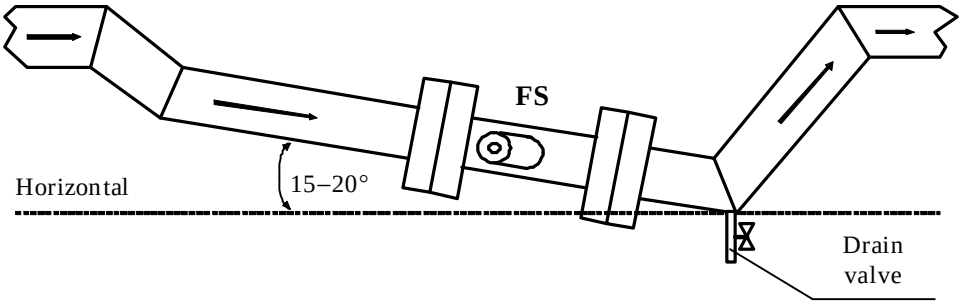


Figure 9.1

To remove heat-conveying liquid from the bottom part of the pipeline (see figure 9.1), it is possible to provide the drain valve.

Please follow the requirements resulted below while installing FS:

The pipeline section chosen for FS installation, should be located in horizontal plane (a deviation from a horizontal within the limits of ± 20 °).

Bushes for flow sensors are also arranged in horizontal plane with a deviation from a horizontal line no more than ± 20 °.

Minimal straight pipe distances downstream of flow disturbances in accordance with specified meter accuracy should be not less than mentioned in the Table 9.1

Table 9.1

Flow Disturbance	Modification M2	Modification M1
Conical Contraction with an angle no more than 20 °	7 DN	10 DN
Single 90 ° Bend	10 DN	15 DN
Gate valves* or two 90 ° Bends in perpendicular planes	15 DN	20 DN
Pump	20 DN	30 DN

Remarks:

* Completely open globe valve is not considered as a disturbance.

The straight upstream pipe section between two serial flow disturbances should be not less than 5 DN. Otherwise upstream straight section should be increased by the length equal to a difference (in millimeters) of the required and real distances between disturbances.

Straight pipe sections upstream and downstream FS-20, while applying conical contraction with an angle no more than 20°, should be not less than 60 mm. In this case welding of special branch from complete set just to a conical contraction is possible.

All other requirements regarding straight pipe sections for FS-20 can be reduced twice.

Distance downstream of FS should be not less than 5 DN for modification M2 and not less than 10 DN for modification M1 for one-beam FS and 5 DN for two-beam FS.

If DN of flow pipeline and DN of straight sections are different then application of conical contraction is required.

The straight pipe section downstream a conical contraction should meet requirements for all flow measurement sections.

To calculate the minimal length of straight sections we use distance equal to DN in mm for appropriate standard size of FS (for example, DN 32 means 32 mm, DN 50 means 50 mm etc.).

It is not allowable to install any kind of disturbances on straight sections upstream a flow meter.

Internal diameter of a straight pipeline section should not differ more than on ± 5 % from:

– digital value of DN in mm for FS with DN20, DN32, DN50. In other words, nominal value of internal diameter of straight section should be 20 mm, 32 mm and 50 mm correspondingly;

– real diameter of FS, which is resulted in chapter 17 “Parameters and characteristics of meter components” for FS with DN65…DN150.

For modification M1 deviation of internal diameter of straight section is permitted, but no more than + 5 % (negative deviation is not acceptable).

9.4 Installation of meter componentry

9.4.1 FS installation

9.4.1.1 FS is insertion type of a flow meter.

9.4.1.2 Delivery sets with FS of DN32 include special pipe branches (nipples), which are welded to straight sections of the pipe during installation.

For other FS the straight sections are included in delivery set according to customer's request.

Pipe branch with sleeve nut, which is included in delivery sets for FS of DN20 and DN32, is a part of straight section and applied for further welding to pipeline to create required distance of straight section.

The axis of a branch pipe and straight section should be a uniform coaxial line without significant jogs and bends. Transition 'jump' from a branch pipe to a pipe should not exceed 0.5 mm (± 2.5%) for FS of DN20 and 0.8 mm (± 2.5%) for FS of DN32.

9.4.1.3 While installing FS-20 (FS connection to welded pipe branches with sleeve nut) its position should be fixed (to prevent a revolution) by a screw driver S = 30 mm, which is based on special faces of FS (see figure in Appendix И).

It is strongly prohibited to apply another FS componentry to prevent FS revolution (PS connectors, FS body, faces with marking).

For tightening a sleeve nut the screw driver S = 41 mm should be applied.

9.4.1.4 While connecting flow meter's flange to the pipe, the flange bore can be reamed to external pipe diameter with the least allowable tolerances. The schemes for flange welding are given in Fig. 9.2 and Fig. 9.3.

Flange mounting to the pipeline should be carried out without metal sagging on the internal pipe surface. Otherwise change of velocity profile can lead to additional meter error.

After flow meter installation the flange painting should be done.

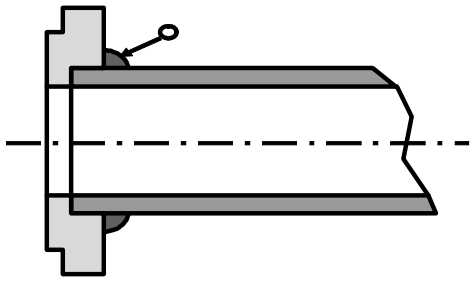


Figure 9.2

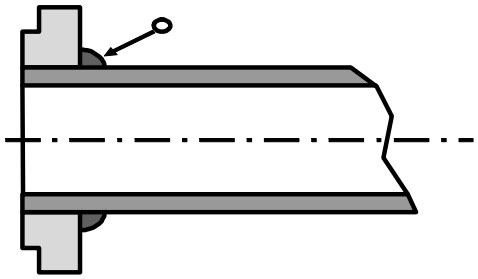


Figure 9.3

WARNING!

Please avoid welding of flanges to the pipeline if FS has been installed! It can lead to flow meter damage because of overheating.

9.4.1.5 Pressure loss on flow measurement sections

Pressure losses at maximal flow rate Qmax don't exceed 0.085 kgf/cm^2 (for all flow meters, if there are no additional remarks).

Pressure loss for flow meters of DN20 in kgf/cm^2 is shown on the plot (see fig. 9.4)

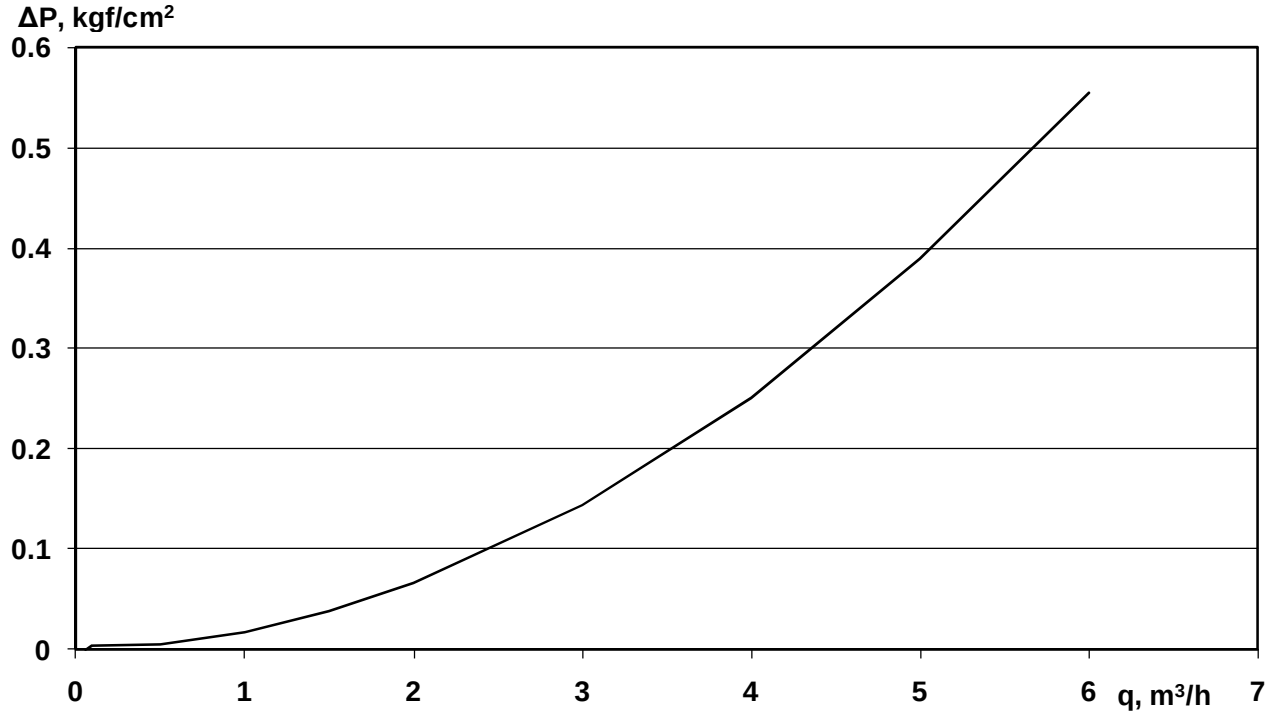


Figure 9.4. Pressure loss for FS-20

Pressure loss (kgf/cm^2) for flow meters of DN32 (with straight sections DN 32) is shown on the plot (see fig. 9.5). The curve 2 demonstrates pressure loss directly on the flow meter of DN32. The curve 1 demonstrates pressure loss on the flow meter, straight sections and conical 10°- contractions, while installing the flow meter of DN32 on the pipe of DN 50.

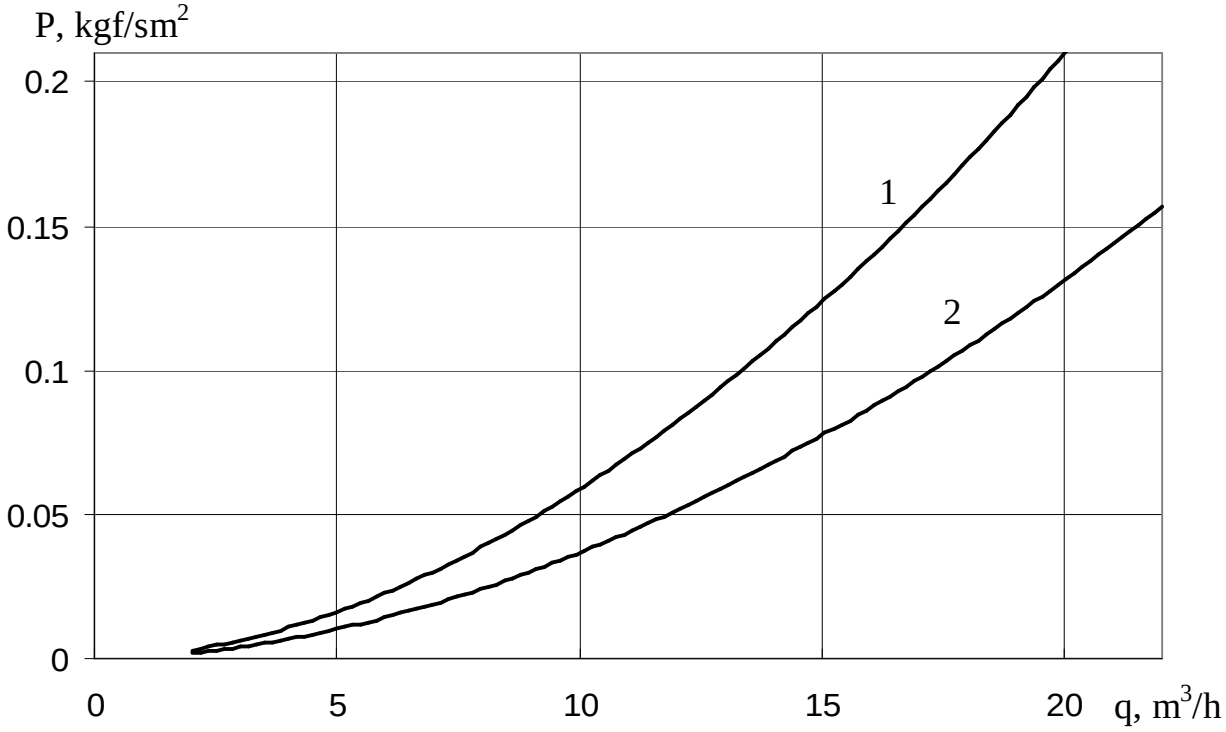


Figure 9.5. Pressure loss for FS-32

For FS-50 pressure loss is resulted in fig. 9.6.

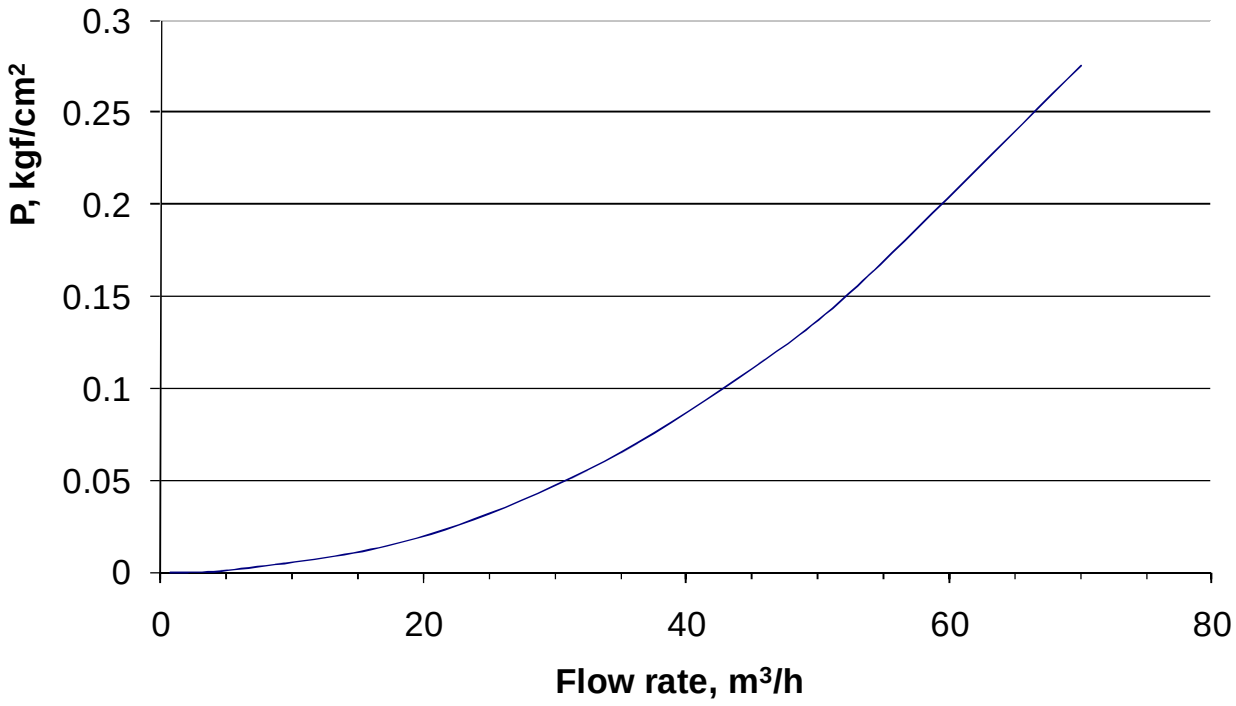


Figure 9.6

9.4.2 Installation of flow sensors

9.4.2.1 The order for installation of flow sensors FlS listed below is applied for FS of DN 32… DN150.

FS of DN20 is delivered with installed and sealed flow sensors FlS, their dismantling can be done only at manufacturing company.

9.4.2.2 After installation of flow measurement section ultrasonic flow sensors should be installed as follows:

– clean internal surfaces of bushes from dust and dirt if necessary;

– for protection of fixing nut and flow sensor materials from diffusion with material of FS it is necessary to grease a bush thread and a lateral cylindrical surface of ultrasonic flow sensors with graphite greasing;

– FlS effective area (edge) should be cleaned from greasing;

– insert ultrasonic flow sensors in bushes (pipe-bends) of flow measurement section. Marking is put on sensor cable outputs. So FlS with marks “11” (or “21” for the second flow measurement channel) should be inserted **in first (according to flow direction)** FS bush, FlS with marks “12” (or “22” for the second flow measurement channel) should be inserted in second (according to flow direction) FS bush;

– at tightening of flow sensor’s fixing nut the force put to a wrench should be equal to 40 … 45 N·m and provide a ‘zero’ gap between FS surface and FlS ring surface outside of its sealing gasket. For FlS installed in FS of DN32 the force is 18 … 20 N·m.

WARNING!

Ultrasonic flow sensors contain piezoceramic elements and thin-walled design elements, which have the increased fragility and do not permit shock and excessive compressing loads.

That is why

IT IS FORBIDDEN:

– to swap around flow sensors for different channels;

– to install flow sensors with marks “11” (“21”), intended for installation in the first flow meter bush (according to flow direction), into the second bush and sensors with marks “12” (“22”) to install into the first bush.

– to drop ultrasonic flow sensors or to knock on them at transportation and installation;

– to carry out mounting and dismantling of FS with installed ultrasonic flow sensors;

– to accomplish metalwork or welding works on the pipeline closely to FS with the installed ultrasonic flow sensors;

– to exceed the mentioned above force for tightening of FlS;

– to dismount stuck to FS flow sensors, while turning them in bushes during regular service.

9.4.2.3 For the removal of the flow sensor its design provides special elements. The manufacturer has developed and can propose special removers or complete set of design documentation for their manufacturing:

– for FlS of DN 32…80 – see remover (SMP. 296454.004);

– for FlS of DN DN 100…150 – see remover (SMP.296454.001).

9.4.3 **Installation of temperature sensors**

Temperature sensors (manufactured by SEMPAL Co.) **RTD-T** can be installed in two ways:

– by screw-driving in bushes (lugs) of the first type welded into the pipeline for direct contact of the RTD with the heat-carrier;

– by screw-driving in thermal pockets, which, in turn, are screwed in bushes (lugs) of the second type. The last ones are welded into the pipeline for contact with the heat-carrier via a protective thermal pocket.

Choosing a way of RTD installation in the pipeline it is necessary to consider, that to obtain a maximal accuracy of temperature measurement the sensitive element of RTD should be arranged as close as possible to an axis of the pipeline. There are three types of RTD with length of 58, 80, 150 mm (type 4, 2, 3 correspondingly) and variants of their angular installation in accordance with specified requirement irrespective of pipeline diameter. The inclination angle and depth of RTD immersing is provided with use of bushes (lugs), the design of which depends on pipeline DN. Recommended variants of RTD depending on FS type are given in tables 9.2 and 9.3. Variants of RTD installation in thermal pockets and without it are given in figures 9.7, 9.8.

Warning! Applying lugs with inclination 45 or 60 °, it is necessary to provide a contact of water with the bottom part of RTD, where thermosensitive element is located.

The installation place for each RTD included in delivery set is given on the meter’s scheme for installation (see the appendix B). The RTD which measures temperature of the water should be installed close to FS. The distance between the RTD and the calculator should not exceed 10 m.

The RTD can be installed on the upstream or downstream sections of FS, but installation on the downstream section is preferable. While installing the RTD after FS, the distance between the bush and FS should be not less than 5 DN and at installation before FS - not less than 10 DN.

After bush welding, it is necessary to process its thread by tap M10x1.5 or M16x1.5 (depending on bush type).

While installing the RTD with inclination 45° or 60°, it is necessary to drill 10 mm hole (16 mm for a thermal pocket) and to saw it up to a necessary oval depending on thickness of a pipe wall (see figure 9.7).

The sealing surface of the bush should be protected from splashes of the fused metal during welding.

Before application of sealing gasket (fluoroplastic ring) a sealing surface of the bush should be greased.

While screwing the RTD in the bush, the force put to a wrench of 200 mm length, should be no more than 5 kg and provide hermetic seal. The deformation of fluoroplastic gasket in the gap between sealing surfaces of RTD and the bush is not permitted.

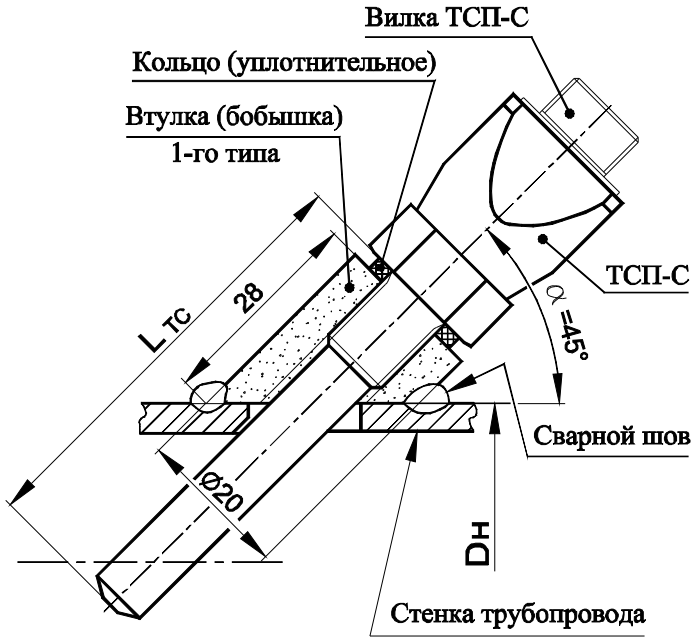
Before screwing the RTD in the thermal pocket it is necessary to be convinced of cleanliness of a thermal pocket and to fill it on 1/8 of volume with high-temperature silicon lubricant of any type.

Table 9.2

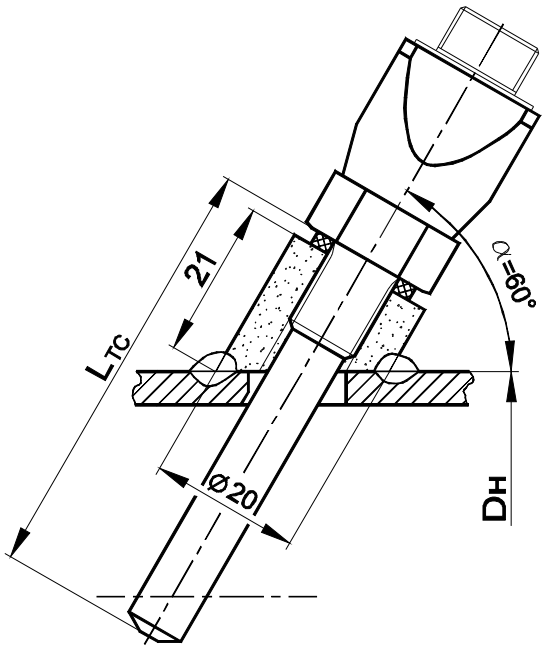
<table>
<tr><th rowspan="2">DN, mm</th><th rowspan="2">Configuration of RTD, nominal length (L_{TD}, mm), type</th><th colspan="2">Configuration variants for bushes of first type (internal thread of bushes is M10x1.5)</th><th rowspan="2">Angle of inclination</th></tr>
<tr><th>Labeling</th><th>Marking</th></tr>
<tr><td>32</td><td rowspan="3">SMP.405212.001-03
L_{RTD}=58; type 4</td><td>SMP.723144.007</td><td>1</td><td>45°</td></tr>
<tr><td>50</td><td>SMP.723144.008</td><td>2</td><td>60°</td></tr>
<tr><td>65</td><td rowspan="3">SMP.723144.009</td><td rowspan="3">3</td><td rowspan="2">90°</td></tr>
<tr><td>80</td><td rowspan="2">SMP.405212.001-01
L_{RTD}=80; type 2</td></tr>
<tr><td>100</td><td rowspan="2">45°</td></tr>
<tr><td>125</td><td>SMP.405212.001-02
L_{RTD}=150; type 3</td><td>SMP.723144.007</td><td>1</td><td>60°</td></tr>
<tr><td>150</td></tr>
</table>

Table 9.3

<table>
<tr><th rowspan="2">DN, mm</th><th rowspan="2">Configuration of thermal pocket, nominal length (L_{TP}), mm; nominal length of RTD (L_{TD}), mm</th><th colspan="2">Configuration variants for bushes of second type (internal thread of bushes is M16x1.5)</th><th rowspan="2">Angle of inclination</th></tr>
<tr><th>Labeling</th><th>Marking</th></tr>
<tr><td>50</td><td rowspan="3">SMP.753137.002-03
(type 4) L_{TP}=56; L_{RTD}= 58</td><td>SMP.723144.008-01</td><td>5</td><td>60°</td></tr>
<tr><td>65</td><td rowspan="3">SMP.723144.009-01</td><td rowspan="3">6</td><td rowspan="3">90°</td></tr>
<tr><td>80</td></tr>
<tr><td>100</td><td rowspan="2">SMP.753137.002-01
(type 2) L_{TP}=78.5; L_{RTD}= 80</td></tr>
<tr><td>125</td><td>SMP.723144.007-01</td><td>4</td><td>45°</td></tr>
<tr><td>150</td><td>SMP.753137.002
(type 3) L_{TP}=148; L_{RTD}= 150</td></tr>
</table>

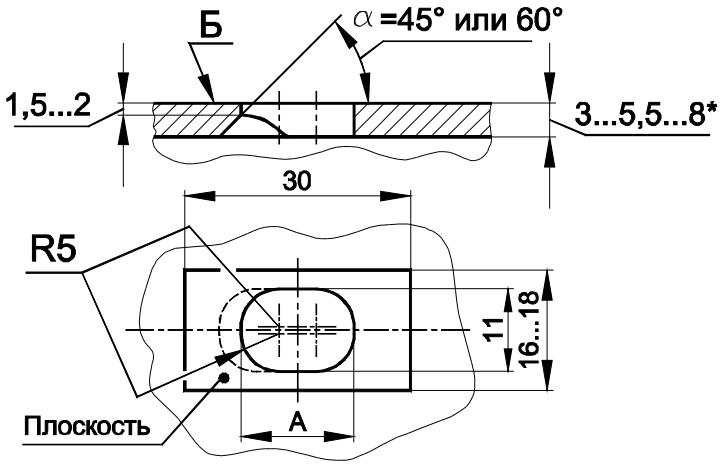


DN-32; DN-40



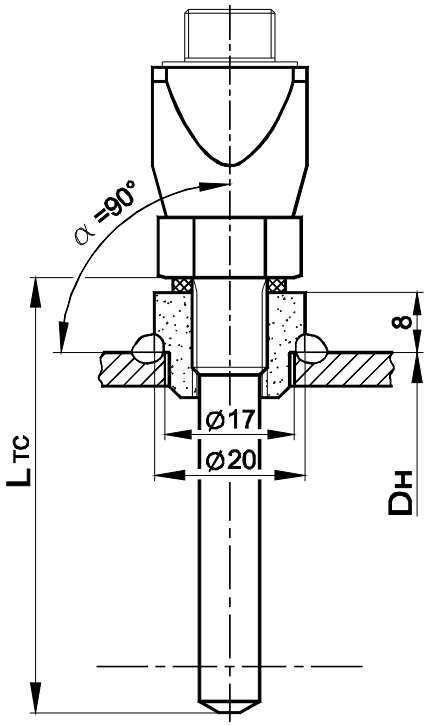
DN-50

Разметка и размеры отверстия
для установки ТСП-С под углом 45° или 60°



Угол α	A, мм
45°	15
60°	13

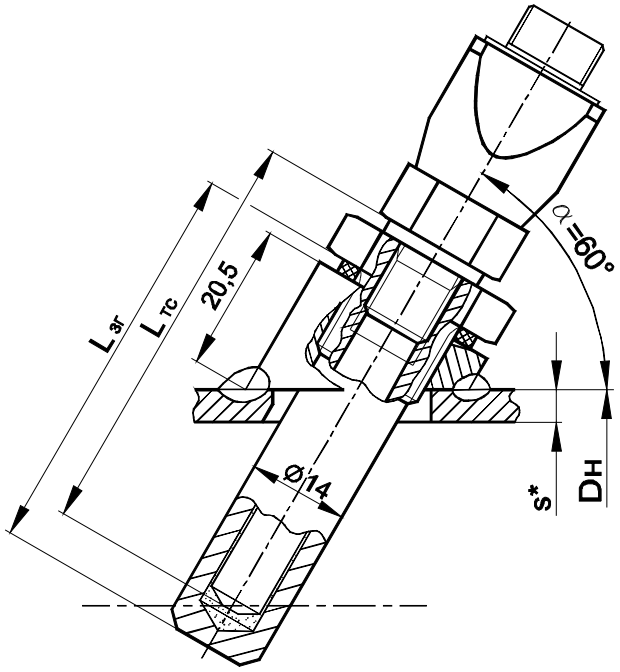
На поверхности Б рекомендуется
для всех вариантов установки
под втулку ТСП-С запилить плоскость



DN-65...100

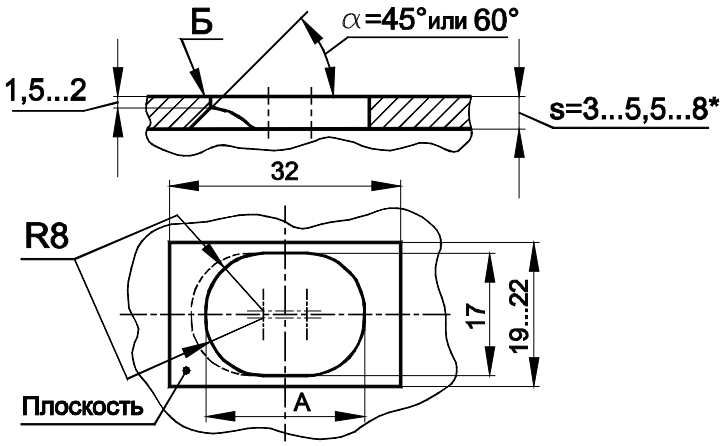
Примечания.
1. Для трубопроводов DN-32 ... DN-100 положение термочувствительного элемента ТСП-С оптимизировано относительно труб водогазопроводных по ГОСТ 3262-76.
2. При установке ТСП-С на трубопроводах меньше DN-32 необходима установка расширителя.

Figure 9.7 Installation of RTD-S of type 2, 3 and 4 without thermal pocket



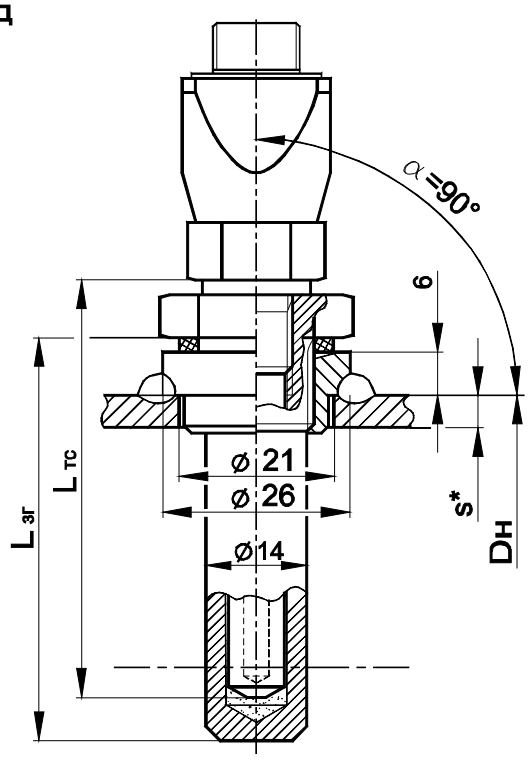
DN-50

Разметка и размеры отверстия
для установки защитной гильзы ТСП-С под
под углом 45° или 60°



Угол α	A, мм
45°	25
60°	22

На поверхности Б рекомендуется
для всех вариантов установки
под втулку гильзы запилить плоскость



DN-65...100

Примечания.
1. Для трубопроводов DN-32 ... DN-100 положение термочувствительного элемента ТСП-С оптимизировано относительно труб водогазопроводных по ГОСТ 3262-76.
2. При установке ТСП-С на трубопроводах меньше DN-50 необходима установка расширителя.

Figure 9.8 Installation of RTD-S of type 2, 3 and 4 with thermal pocket

9.4.4 Installation of pressure sensors

Pressure sensors are installed strictly in vertical position. The scheme of installation is represented in the appendix Ж.

Power module, which is used for powering of pressure sensors, should have a galvanic separation with power network.

Application of pressure intake devices is obligatory!

9.4.5 Mounting of the calculator

The calculator can be fixed in horizontal position (on the table, stand or shelf) or in vertical position (on the wall or in device enclosure).

For fixing of the calculator special accessories in delivery complete set are provided. The scheme for fixing is given in the appendix В.

9.4.6 Cabling

After installation of all meter components their bond by means of connecting cables from the delivery complete set is made in following sequence:

1) cabling;
2) cable connection to the calculator, RTD and ultrasonic flow sensors.

Cabling is carried out under following requirements:

– cable mounting should exclude a possibility of its contact with pipelines and other elements if their temperature is below a minus 40 C or above 70 C;

– cable protection against mechanical damages should be carried out by cable grooming in pipes, hoses, ducts, etc. Cable grooming for one meter in one protective housing is permitted;

– cable grooming of two and more meters should be provided in protective housings separated from each other on a distance not less than 5 cm for prevention of mutual electromagnetic inductions

– after cable grooming it is necessary to make their connection to meter components considering marks of cables.

The rest of the cable should be left in device enclosure.

WARNING!

- **Grooming of connecting cables near power supply lines or in their protective housings (housings of power lines) is forbidden.**

Cable connection to the calculator and to all sensors should be carried out as follows: while defining ‘switch’ positions on connectors, **plug connectors accurately, without appreciable effort. Mutual rotation is not permitted**; **after all a sleeve nut should be twisted** to prevent possible crumpling (bend, fracture) of contact items (pins) at partial lengthwise coupling.

While connecting sensors it is necessary to strictly follow the marks on device cable and flow sensor cable outputs.

In Table 9.4 marking on communications channels has been adjusted with marking on flow sensor cable outputs (for 1-beam flow meters).

Table 9.4

Cable function (connected unit)	Marking on device cable	Marking on flow sensor cable outlets	
		Marking	Arrangement
FlS1 of channel 1	A11	11	First downstream
FlS2 of channel 1	A12	12	Second downstream
FlS1 of channel 2 (FlS3)	A21	21	First downstream
FlS2 of channel 2 (FlS4)	A22	22	Second downstream

In Table 9.5 marking on communications channels of device cable is given to connect temperature sensors, pressure transducers and peripheral devices.

Table 9.5

Cable function (connected unit)	Marking on device cable	Cable function (connected unit)	Marking on device cable
TS1	B1	PT1	C1
TS2	B2	PT2	C2
TS3	B3	RS232	D1
		Pulse outputs	D4

Structural and basic schemes of device cable are given in the appendix Е.

After meter commissioning and also in cases of repairs, verification and adjustments, service worker should record corresponding information in Table 19.

CAUTION! IT IS FORBIDDEN:

1 To break the procedure of cable connection according to marking in tables 9.4 – 9.6.

2 To swap RTD of temperature sensors TS1, TS2, TS3 (see the Appendix Б) and pressure sensors PT1 and PT2.

3 To increase or shorten the length of cables of ultrasonic flow sensors FlS.

4 To apply FS, RTD, ultrasonic flow sensors FlS and calculators from different delivery sets.

5 Cable twisting, kinking and sharp bends is not permitted while connecting to FlS.

CAUTION!!!

If it was required to make welding during device commissioning, the meter should be switched off and device cable should be disconnected from the calculator housing. Otherwise the meter can be damaged.

10 Setting-up Procedures

10.1 While meters work with additional devices (PC), these devices should be connected to meters strictly according to maintenance documentation.

10.2 For comfortable work with the meter (after its purchase and before installation) and for check of meter working capacity together with ultrasonic flow sensors it is necessary:

1) Assemble a flow meter section with rubber or paronite gasket (thickness of 1-2 mm) and technological cap at the end face, install it vertically, fix flow sensors, and completely fill FS with water.

2) Check up all items in **«Indication of main parameters»** mode, check up all items in **"Check"** mode and also it is obligatory to provide zero setting in **"Setup"** mode to correctly repeat this operation while installing device on the object (the description of operating modes is also given in Chapter 11).

10.3 **While installing device on the real object** it is necessary to fill with water the pipeline with installed flow measurement section. Run through FS the heat-carrier (water) with increased volumetric flow rate during 10 minutes. Be convinced of no leakage in places, where meter components are installed, and no error messages on the digital display of the calculator. The list of these messages is resulted in Chapter 13

10.4 Accomplish mentioned hereinafter actions in **«Setup»** mode.

To login in **"Setup"** mode see instructions described in item 11.2.8, the order of menu access in **"Setup"** mode is described in item 11.2.5, and also in Appendix Г.

In **"Setup"** mode:

– set hydraulic zero for the channel of volume measurement;

– set a proper archiving format for the water volume data;

– set «In account» account mode. At this time reset of all meter parameters for certain calculating channel would be done.

For zero setting following actions should be done:

– zero setting should be carried out not earlier than in 10 minutes after battery installation.

– cut off a water flow, but FS should remain completely filled with water.

– provide zero setting according to “Setup” menu item.

In case of failure or wrong zero setting the measurement error increases and can exceed permissible value. Reset of device readings at its commissioning is blocked, if setting of hydraulic zero is not made. Detailed information about zero setting is given in Appendix M **“How to set hydraulic zero”.**

If during meter startup its commissioning was not provided, a proper warning will be displayed on the indicator.

After ending of the above-stated operations meters are ready for functioning.

WARNING!

– While in service it is forbidden to disconnect sensors, to change arrangement of sensors (to prevent such not authorized actions **a mechanical socket sealing** of all FlS, TS, PT is stipulated), to switch off the calculator, to install meters on the pipeline with incomplete (partial) water filling of FS or on the pipeline supplying the water in steam condition. In all above-stated cases the water meter will register failure operating time, which is subtracted from the time of water volume measurement. Power off time (time with disconnected battery) isn’t considered during failure operating and would be displayed in a mode **«Indication of additional parameters»**.

– If the water was cut off for a long time (interheating period, repair of the system, etc.) and it had led to occurrence of stagnations in the pipeline (drains, a rust, bubbles, etc.) it is recommended to set the “Stop” mode and to provide the guaranteed absence of the water in a flow measuring section.

– Scum on internal FS walls reduces the real FS diameter and can lead to overestimation of water flow rate readings. Therefore it is necessary to provide maintenance service of meter (see Chapter 12).

During each operation cycle (1 - 2 seconds) the water meter carries out self-diagnostics of a technical condition by several criteria. In case of measurement section failures, breakage of flow (temperature) sensor cables, absence of the water, etc., storage of integral parameters (water volume and mass, and non-failure operating time) is discontinued and the error message is appeared (see Chapter 13).

11 The operating procedure

11.1 Requirements to the personnel.

The maintenance personnel should be completely acquainted with present OM.

11.2 **Structure of the menu** of control of the meter.

Control of the meter (a readout and specification of operating mode and meter parameters) is carried out by means of proper menu item selection.

Items of Menu are displayed in the top row of meter indicator.

Use of the menu (switching of items) allows to get the information about measured parameters values, parameters of the meter and also to carry out meter verification.

Selection of menu items and changing (input, setting) of parameters is carried out by pressing buttons on the calculator. Sequence of operations to select the certain menu item and to input parameter value or to select a parameter from the list is given in the Appendix D.

All measured quantities, meter parameters and commands for meter control are combined in some sections - **modes of control** of the meter.

Some service modes ('Setup', 'Verification') are protected from non-authorized access by the password.

The meter modes are given in the Appendix Г.

11.2.1 'Indication of main parameters' Mode.

The device switches to '**Indication of main parameters'** mode after battery installation, after device set-up in **'Setup' mode**, after ending of work in **service** modes (**'Check'**, **'Verification'**), and also at automatic returning to '**Indication of main parameters'** mode if buttons are inactive.

Depending on meter configuration the proper measured parameters, which meet to a given configuration, are displayed on the calculator indicator.

In this mode error messages are shown on display.

Meter has three *accounting* mode:

– "**Not in account**" – this is initial mode. In this mode it is possible setup some parameters in "Setup" menu. This mode indicated by periodically display text "**no rSt**";

– "**In account**" mode. This is main mode for accounting. There is no additional indication for this mode.

– "**Stop**" mode. This mode can be activated, when no water in pipe for long period, etc. In this mode no data are placed in archive and no errors indicated.

11.2.2 'Errors' mode.

The menu of this mode is appeared only if some errors in device functioning take place. This mode is used for presentation of complete (not only code, but text) information about running errors. It is possible to see all registered to this moment errors.

Doesn't have impact on measuring process.

11.2.3 'Indication of additional parameters' Mode.

This mode is intended for displaying of minor (rarely viewed) measuring magnitudes. Doesn't have impact on measuring process.

While working in '**Indication of main parameters'** and '**Indication of additional parameters'** modes in worst-case situations **the code and explanation** of the failure is displayed (see Chapter 13).

11.2.4 ’Check’ Mode.

’Check’ mode is intended for indication of parameters which should be checked. **’Check’ mode** doesn’t interrupt measuring process and can be used either by auditor or by user. In particular, in this mode counters of entries into ‘Setup’ and ‘Verification’ modes are displayed.

11.2.5 ’Setup’ mode.

’Setup’ mode is used by consumer during meter commissioning for hydraulic zero setting in volume measurement channels, input of necessary parameters (pressure, cold water temperature, etc.), and also for choosing an appropriate mode.

It should be considered that while metering ‘Verification’ mode is blocked. In addition, those items of ‘Setup’ mode which should be unchangeable during process of measurement are also blocked.

11.2.6 ’Verification’ Mode.

’Verification’ Mode is used to evaluate measuring errors and calculating errors of basic meter performance, and also to check correctness of their indication.

’Verification’ Mode is used for automation of heat meter performance verification in case of regular verification. Verification is conducted only by authorised personnel.

11.2.7 ‘Limit prolongation’ Mode.

It is intended for password entering if time limit prolongation is needed.

11.2.8 Password entering .

Entry into service modes **‘Setup’ and ‘Verification’** is permitted only after entering the proper passwords **to avoid non-authorized access** to parameters saved in calculator memory. To run a proper mode in the menu password is requested.

The manufacturer set the following **standard passwords for service modes** (see table 11.1) at device shipment:

Table 11.1

MODE	STANDARD PASSWORD
’Setup’	25205757

On customer’s demand the manufacturer can set **INDIVIDUAL PASSWORDS** for service modes that is equivalent to additional **ELECTRONIC SEALING** of the calculating unit and provides inaccessibility of unauthorized users to saved up measuring information.

The password is represented by 8-digit integer number to get access to one of service modes.

Symbols **«-»** on the indicator mark bits for entering password digits.

Non-masked (open) value of an input digit is displayed only in that bit, in which input of its values (editing) is provided.

While entering a password, press the button "To the right" to move the cursor on one bit to the right. It allows to change any bits of the password.

Pressing buttons «Up» and «Down» leads to a change in the digit value.

Pressing the button «To the left» means ending of password entering.

If during 2 minutes there was no pressing a button the meter switches from ‘Enter password’ mode to ‘Indication of main parameters’ mode.

On figure 11.1 the way to run ‘Setup’ mode is given.

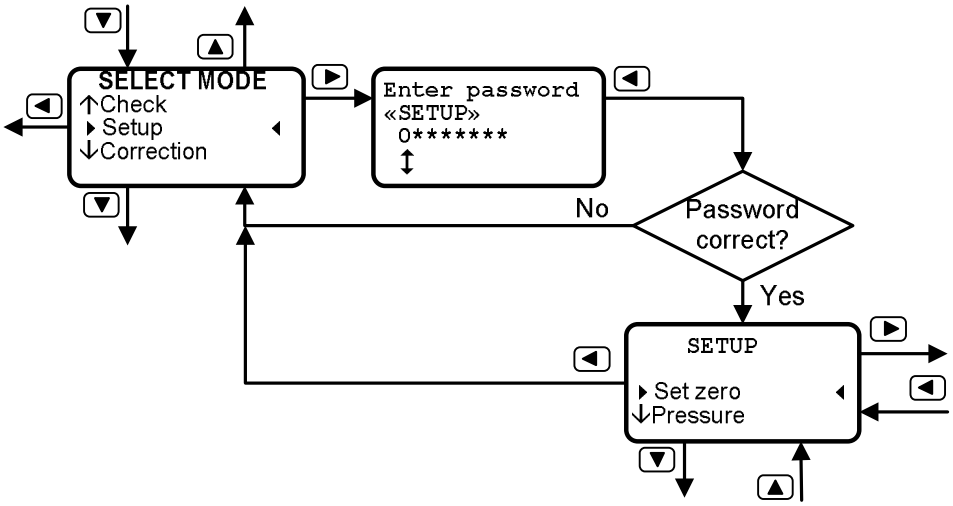

SELECT MODE
↑Check
Setup
↓Correction
Enter password
«SETUP»
0*******
No
Password
correct?
Yes
SETUP
Set zero
↓Pressure

Figure 11.1

12 Servicing

12.1 The Instruction to the representative of inspecting service

12.1.1 The SVTU-11T heat meter is protected from consumer intervention as well as intervention of heat supply organization. Any changes of a water meter parameters can be carried out only in **'Setup' and 'Verification' service** modes. To except a non-authorized access into device functioning process and prevent possible attempts to change any device constants (calibration factors of thermoresistor Kdl and Krc, flow rate conversion ratio, geometrical parameters of a flow meter), the fact of login or running through these modes is fixed in the **'Check'** mode. **The opportunity to check inputs in the specified modes** is equivalent to a mechanical sealing (i.e. it substitutes mastic seals, branded labels, etc.), so it is **electronic way of sealing of the calculator**. Therefore the basic attention should be paid to the number of entries into **service** modes. Difference of this number from the recorded one at the moment of device commissioning (release date according to the certificate) should be considered as damaging of the seal installed by inspecting organization. The possibility of mechanical sealing of the calculating unit with the use of sealing cups with holes on device case is stipulated. So, the fact of intervention in device functioning should be registered by analysis of event journal. All user's actions, which lead to change in device readings are dated in the event journal. If the event journal has a record about entering into service mode, but no records about meter parameters changing, it means that the user logged in and immediately logged out without changing meter parameters and performance.

12.1.2 In doubts of correct installation or proper operation of the water meter it is necessary to run **'Check'** mode and to compare correctness of the entered values for RTD temperature coefficients, FS exact diameters, distances between flow sensor transmitters and FS conversion ratios to data resulted in Chapter 17 'Parameters and characteristics of meter components'. Thus compared values can differ in limits, which are not exceeding units mentioned in Chapter 17 of this OM.

12.1.3 It is necessary to consider, that water meter commissioning begins with **reset** (zeroing) of its integrated indications (accumulated measuring data) on setting account mode to "In account". Reset of indications also should be carried out after meter repair or verification.

12.1.4 Difference between power on time and time of correct work means that a water meter operated incorrectly (switching-off, breakage or short circuit of sensor cables, absence of the water, etc., see item 10.8). Therefore sealing of flow sensors or their connectors is not obligatory. However, the possibility of mechanical sealing for flow sensors and their connectors with a use of proper holes in clamping nuts of FlS and connector housings is stipulated.

12.1.5 To except a non-authorized influence on RTD parameters and so on temperature measurement accuracy it is necessary to mechanically seal up the temperature sensor using a hole in RTD housing.

12.2 Maintenance service is carried out by the representative of service organization. During servicing it is necessary to carry out the security measures interpreted in Chapter 8.

12.3 Battery replacement.

Battery resource is indicated in ‘Check’ menu and also included in current status report. Battery replacement (lithium battery, voltage 3.6 V) should be done at least once every 6 years. Replacement can also be carried out sooner or later depending on meter operation.

Battery replacement can be done without breaking of measuring process or with breaking when verification is needed. Battery should be ordered only at manufacturing company. Installation of other type batteries is forbidden.

The order of battery replacement:

– run ’Setup’ mode, ’Battery replacement’ item;

– after confirmation of replacement, meter switches to battery replacement mode and «battEry» is indicated on the meter display. Being in this mode meter stops measuring process and wait for battery replacement;

– unscrew four screws that fix the cover of battery slot on the back side of the meter, remove the battery and disconnect it from the meter;

– install the new battery, put it in the slot so, that the wire should not be bent by slot cover;

– close the cover of battery slot and screw the four screws to provide tightening of the slot gasket;

– press «To the right» button on the meter keyboard. Meter switches from battery replacement mode to measuring process.

Time of starting and ending of battery replacement is recorded in the event journal and time period of replacement is identified as meter non-work time.

Warning!

After switching off the old battery the new one should be switched on in 5 minutes. Otherwise meter stops metering and resets current time. This also will be registered in the event journal.

If after entering battery replacement mode procedure is not completed within 10 minutes, the meter switches to a regular measurement mode.

The order of battery replacement is represented in Figure 12.1.

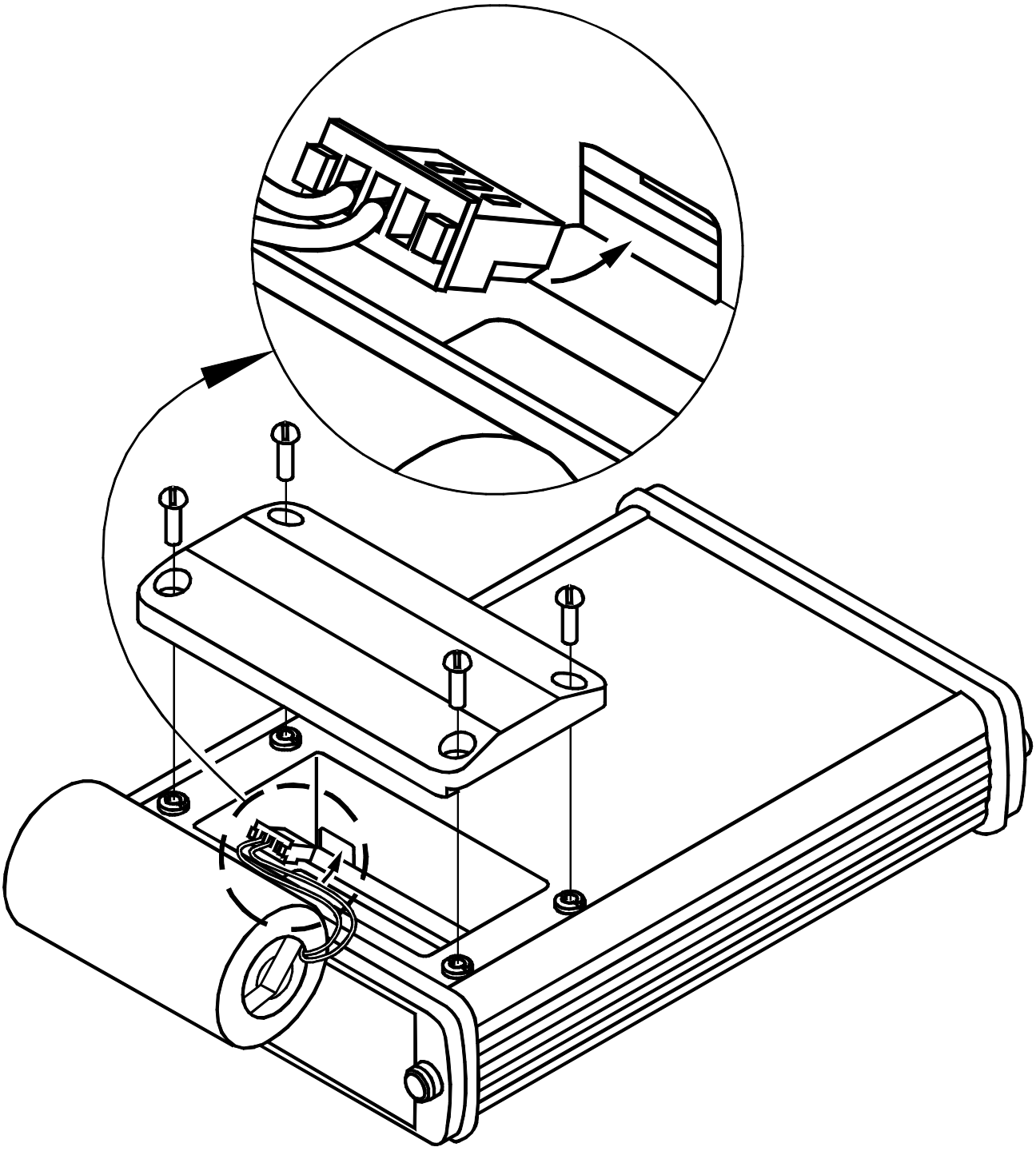


Figure 12.1

12.4 There are two types of maintenance for meters: #1 and #2.

12.4.1 **Maintenance #1** is carried out on a meter operation place once in six months and includes visual check and check of working capacity.

Check visually:

- no leak in places of meter installation;
- reliability of contact joints;
- no mechanical damages on plastic details;
- safe isolation of connecting cables;
- measuring data output in accordance with items 11.2.1.

At the end of the heating season it is recommended to clean of flow sensor surfaces using washing-up liquids, weak solutions of alkalis or acids (without mechanical cleaning). If water meter was out of service for a long period of time it is recommended to switch the meter into 'Stop' mode and provide the guaranteed absence of the water in a flow measurement section.

12.4.2 **Maintenance #2** is carried out before regular verification of meters.

Following operations should be carried out:

- operations, provided by maintenance #1;
- visual check of precipitation on the inner surface of flow measurement section (FS);
- dismantling and cleaning of FS according to item 12.5.1 and dismantling and cleaning of RTD if severe precipitation has been detected.

Dismounting and cleaning of FS of DN20 should be carried out only at manufacturing company or in authorized labs for verification.

Dismounting and cleaning of FS is carried out in the following way:

- to dismount ultrasonic flow sensors (except for FS of DN20);
- to dismount FS from the pipeline (if possible);
- to carry out visual check of FS and, if necessary, to clean mechanically its inner surface from precipitation;
- to wash out inner FS surface by a synthetic washing-up liquid of any type and then by water.

12.5 Meters (calculator, ultrasonic FlS, temperature sensors, flow measurement sections) undergo a verification after maintenance #2. Recalibration interval is no more than 4 years.

FS of DN20 should undergo verification procedure with undamaged seals on FlS.

13 Typical faultinesses and methods of their elimination

While in operation, the meter constantly checks both the working capacity of its units and the working capacity of sensors (flow sensors, temperature sensors, etc.) connected to the meter.

Diagnosed errors are subdivided into groups according to a priority (importance for realization of correct measurement). The group number is less, the error importance is more. The error code includes its number and number of the measurement channel, in which there was an error.

Displayed error looks on the indicator as follows (example):

Er 1_3_1

Here 1_3_1 is error code, which consists of group number (first digit), error number (second digit) and measurement channel number (third digit). In this case measurement channel number is a number of temperature sensor. Simultaneously only one error can be displayed on the indicator. To view all errors it is recommended to use ‘Errors’ mode.

13.1 System errors.

As mentioned above, the lower number of errors, the higher its priority. Without priorities, there are system errors - errors of internal hardware of the meter, which generally preclude the operation of the meter. If there are such errors, no parameter is measured and accumulation of any parameters is not provided. Such errors are displayed on the indicator as follows (example):

«SYSErr02»

Number means an error type. System errors are registered in the event journal with some text decoding, if possible.

In case of system error the meter should be delivered to manufacturer for repair.

13.2 Error group «0».

In group «0» following errors are included:

– «**0_1_0**» - The error of flow rate measurement. Flow rate measurement in both channels is impossible.

– «**0_2_0**» - Error of ADC. Temperature measurement in all channels is impossible.

– «**0_3_0**» - The error of calibration of temperature detector. Calibration parameters have been distorted somehow.

– «**0_4_0**» - The error of calibration of pressure transducer. Calibration parameters have been distorted somehow.

–

13.3 Error group «1».

This group includes errors referring to temperature measurement (the sign «x» specifies number of the channel):

– «**1_1_x**» - break of TSx.

– «**1_2_x**» - fault of TSx.

– «**1_3_x**» - TSx is failed. Resistance of mentioned TS is out of specified limits

– «**1_4_x**» - The error of incorrect coefficients for TSx, while calibrating coefficients are entered manually.

– «**1_5_x**» - TSx is below the tolerance. Measured temperature value is below permissible minimum (below -50 °C).

– «**1_6_x**» - TSx is over the tolerance. Measured temperature value is above permissible maximum (over +150 °C).

If TS with an error is involved into flow rate measurement process, then all measurements in the proper flow measurement channel would be canceled. If TS is used for heat quantity calculation then heat quantity is not determined.

13.4 Error group «**2**».

This group includes flow rate measurement errors referring to one of applied pair of flow sensors (one of enabled chords for sound propagation).

– «**2_1_x**» - the error of flow sensors in beam «x». This error can be caused by following reasons:

– failure of flow sensors;

– failure of flow sensors' cable – breakdown or fault;

– no water in FS.

13.5 Error group «**3**».

This group includes errors referring to flow rate measurement. If multi-beam flow meter is applied the error in measurement along one of sound paths not necessary leads to flow measurement error of flow meter.

– «**3_1_x**» - measurement by FSx. Flow measurement in mentioned FS is impossible.

– «**3_2_x**» - temperature of FSx. Because of malfunction of TS, which measures temperature in specified FS, a flow rate measurement is impossible. This error always takes place with an error of measurement by TS. This error is displayed (and is brought in error archive) to define interrelation between a temperature measurement error and a flow rate measurement error.

– «**3_3_x**» - high velocity in FSx. The volumetric flow rate in mentioned FS exceeds maximum value for this FS type more than twice.

If the error has been registered in the flow measurement channel, which is used for heat quantity calculations then heat quantity is not calculated.

13.6 Error group «**4**».

Errors of this group refer to heat quantity calculation (sign «x» specifies the number of the channel). Here the errors in temperature ratios, which are necessary for heat quantity calculation, are analyzed:

– «**4_1_x**» - $t_{ret} > t_{flow} + 2.5$ °C. The temperature of the return pipeline exceeds the temperature of flow pipeline more than on 2.5 °C. Heat quantity calculation is impossible. If temperature excess is in a range: 0 up to 2.5 °C, a temperature difference is accepted equal to 0, and the error is not registered

– «**4_2_x**» - $t_{cw} > t_{flow} + 2.5$ °C. The temperature of cold water exceeds water temperature in flow pipeline more than on 2.5 °C. Heat quantity calculation is impossible. If temperature excess is in a range: 0 up to 2.5 °C, a temperature difference is accepted equal to 0, and the error is not registered.

– «**4_3_x**» - $t_{cw} > t_{ret} + 2.5$ °C. The temperature of cold water exceeds water temperature in return pipeline more than on 2.5 °C. Heat quantity calculation is impossible. If excess is in a range: 0 up to 2.5 °C, a temperature difference is accepted equal to 0, and the error is not registered.

– «**4_4_x**» - the error of pressure measurement in flow pipeline. It is registered only if measured pressure is considered in heat calculation process.

– «**4_5_x**» - the error of pressure measurement in return pipeline. It is registered only if measured pressure is considered in heat calculation process.

– «**4_6_x**» - the error of cold water pressure measurement. It is registered only if measured pressure is considered in heat calculation process.

These errors don't affect flow rate and temperature measurements.

13.7 Error group «**6**».

– This group includes the errors of pressure measurement (the sign «x» specifies number of the channel):

– «**6_1_x**» - PSx is below the tolerance. Measured pressure is below zero. It can be caused by object conditions (underpressure), or with breakage of certain PS.

– «**6_2_x**» - PSx is over the tolerance. Measured pressure is above 20 kgf/cm^2. It can be explained by the fact of increased pressure on the object and faultiness of PS.

– «**6_3_x**» - PSx parameters are incorrect.

Pressure measurement errors don't affect flow rate and temperature measurements.

In hourly and daily archive printouts there is a value of error appearance duration (Terr). This value includes errors referred to flow measurement channel and errors, which lead to impossibility of flow rate measurement. Errors of a flow meter and errors of temperature measurement are included here.

Printouts have a field 'Error types', in which presence of certain error type is displayed. In total up to four various types of errors can be displayed within an hour and up to 8 types of errors can be displayed within a day. The error is displayed on printout only if its duration exceeds 1 minute.

Errors are displayed by letters of the Latin alphabet. The certain letter meets to each type of errors:

A – system errors (error group 0);
B – temperature measurement errors (error group 1);
C – flow rate measurement errors (error group 3);
D – flow rate measurement errors (error group 2);
E – heat calculation errors (error group 4);
F – pressure measurement errors (error group 6);

For example, record 'BD' means, that there were errors of group 1 and group 2. More detailed information on these errors can be taken in the error archive printout.

In error archive printout the error code in the above described format and duration of this error in hours are mentioned. Within one hour up to 4 polytypic errors can be registered (in archive) and for a day - up to 8 polytypic errors can be registered. If the number of errors

is more than it was mentioned, than the most significant errors are stored. For example, the error of one TS can cause some more other errors, so only error of TS will be displayed.

The list of certain faultinesses and methods of their elimination are resulted in table 13.1.

Table 13.1.

Appearance of faulti-ness	Possible reason	Method of elimination
1. There is no indication on the indicator	The battery is completely discharged or not installed.	Replace (install) the battery.
2. The meter does not react on button pressing	The calculator is faulty	Provide a repair of the calcu-lator

The notice: A repair of the calculator should be provided by specialized manufacturing division.

14 Storing

14.1 Heat meter storing can be made in heated or unheated storehouses.

Meter life cycle:

– in heated storehouse is no more than 10 years;

– in unheated storehouse is no more than 5 years.

14.2 Storage conditions for meters:

1) in heated storehouse:

– ambient temperature can vary from 0 up to 50 °C;

– relative air humidity is up to 80 %, while temperature is 30 °C and below without moisture condensation;

2) in unheated storehouse:

– ambient temperature can vary from minus 5 °C up to 50 °C;

– relative air humidity is up to 95 %, while temperature is 35 °C and below without moisture condensation.

14.3 At long-term storage in unheated storehouse meters should be placed in an additional cover from a polyethylene film.

15 Transportation

15.1 Meters can be transported by all modes of transport. Their packing should provide protection against direct influence of atmospheric precipitation.

While transporting by air transport, meters in packing should be placed in hermetically compartments.

15.2 Transportation conditions:

– ambient temperature:

– for calculator can vary from minus 20 °C up to 50 °C;

– for FS can vary from minus 50 °C up to 70 °C;

– relative air humidity is up to 98 %, while temperature is 35 °C;

– transport jolty with acceleration 30 m/sec^2 , while frequency varies from 80 up to 120 beats per minute.

15.3 Meters are steady against influence of sinusoidal vibrations, while frequencies vary from 5 up to 35 Hz with amplitude up to 0.35 mm.

15.4 Throwing of meters during delivering and unloading it is not permitted.

FS and packing box with the calculator should be fixed to except accidental moving at shipment in vehicle.

16 Guarantee of manufacturer

16.1 Manufacturer guarantees that produced heat meters meet to all requirements of their specifications within 48 months from the moment of shipment if the consumer observes the following conditions:

– installation, starting-up and adjustment of the heat meter is made by the organization, which has the manufacturer’s sanction;

– a mark of the organization, which has provided installation, starting-up and adjustment of the heat meter should be put in section 19 of present Operating manual ;

– conditions of service, transportation and storage meet to requirements in Chapters 8-11, 14 and 15 of present Operating manual.

16.2 Guarantees are extended on defects of meter components in delivery complete set in case of manufacturing defects, defects of materials and componentry.

16.3 Guarantees provide replacement of defective componentry and check of meter working capacity by manufacturer.

16.4 Faulty device should be delivered to the manufacturer for testing and repair.

16.5 Unsealing of the calculating unit (breaking of seals) before its returning to the manufacturer is not allowed.

16.6 Guarantees do not provide expenses indemnification for dismantle, return and repeated installation of the device, and also any secondary losses caused by malfunction.

16.7 In case of malfunction identification during a warranty period the consumer should report unsatisfactory condition of the equipment to manufacturer:

SEMPAL Co. LTD
3 Kulibina Str., Kyiv, Ukraine, 03062
Phone/Fax: (+38 044) 239-2197, 239-2198.
http://www.sempal.com

16.8 Do not put in claims to a heat meter in following cases:

– installation, starting-up and adjustment have been carried out by organization without manufacturer's license on carrying out of such works;

– damage of seals on the calculating unit;

– the expiration of a warranty period;

– violation of service, storage and transportation regulations stipulated by the operational documentation.

16.9 After ending of a warranty period or loss of the right on warranty service the manufacturer makes repair of heat meters according to a tariff.

Appendix A
Meter designation

Example of designation: **« SVTU11T – M1 – 4 – RU50/RU50 – 4b45p/4/0 – 3/5 – 3/5/0 – 3/5 – 1/2»**

Interpretation:

SVTU11T -	**M1 –**	**4 –**	**RU50/RU50n –**	**4b45p/4/0 –**	**3/5 –**
Water meter name	Water meter modification	Configuration	Types of RU. “n”- delivery without flanges	Types of applied RTD (0 – RTD isn’t applied) “b”with digit –angle of inclination of the bush, “p” – if there is a thermometer pocket	Cable length up to corresponding RU, m

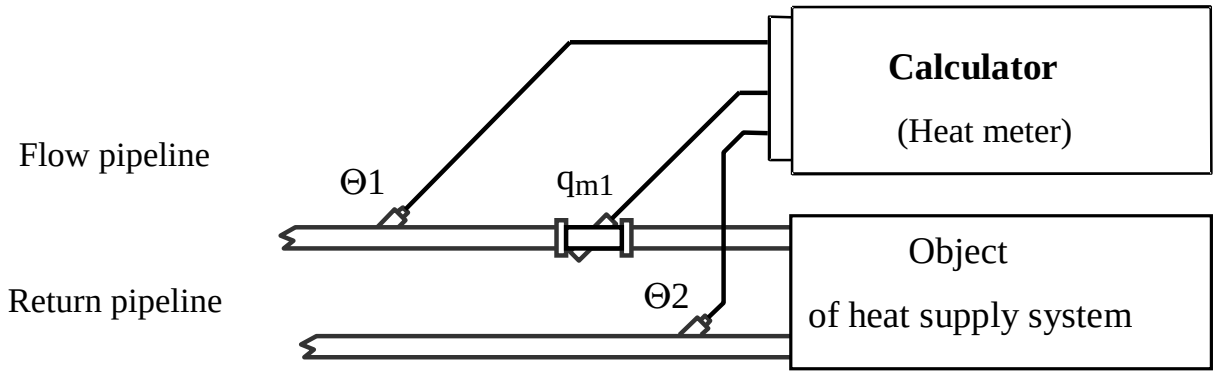
3/5/0 –	**3/5/1 –**	**1/2**
Cable length up to corresponding RTD, m	Cable length up to PS, m, and number of PS for delivery (3^d digit)	Cable length RS232C / pulse output cable, m

Appendix B
Schematic circuits for meter installations
in different configurations

In listed below formulas there are following notations:

Q is heat quantity (J);
h is specific enthalpy (J/kg);
q_m is mass flow rate (kg/h);
t is time (hour).

Configuration 2

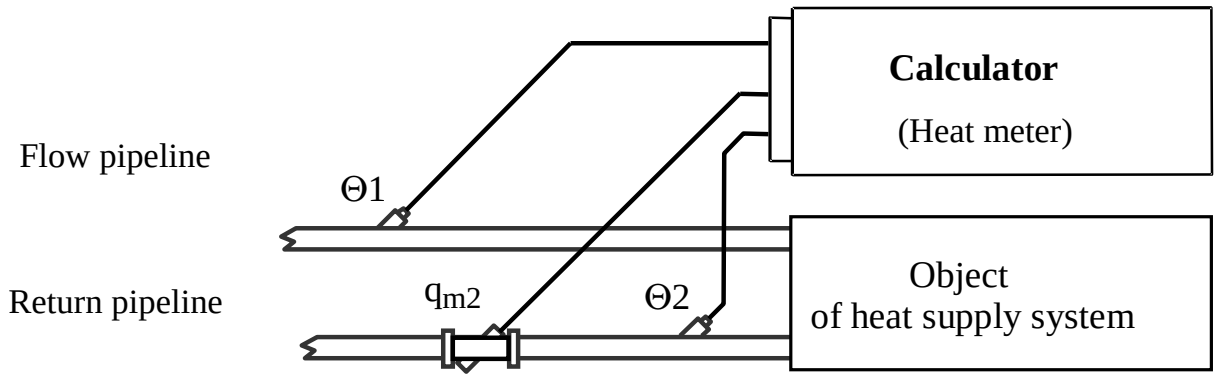


$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system

Figure B.1

Configuration 2/1

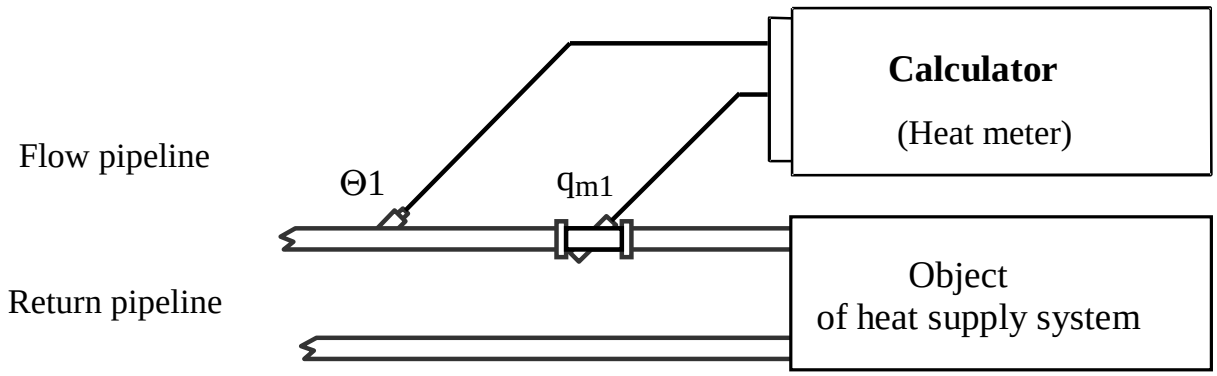


$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system

Figure B.2

Configuration 2/2

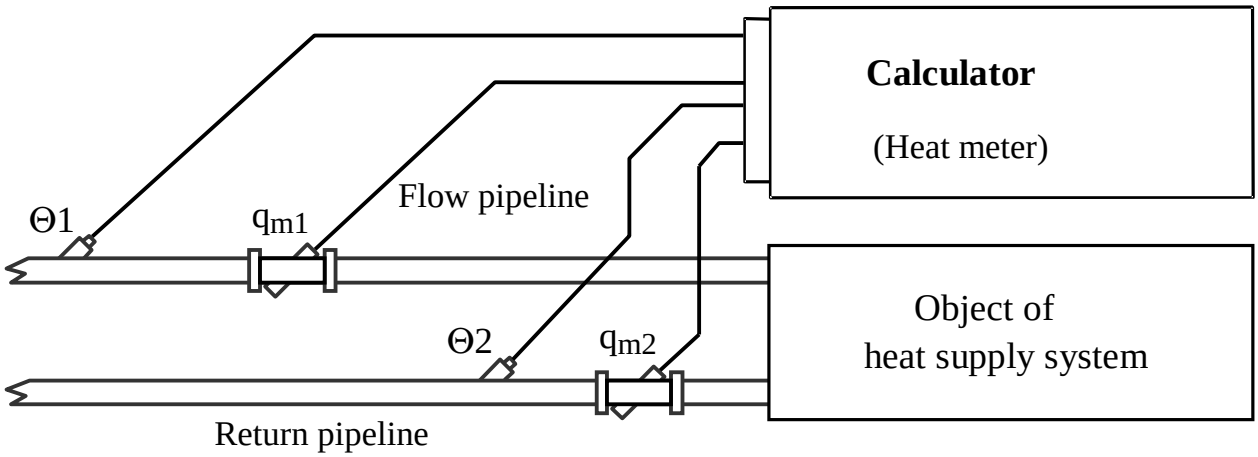


$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system
The return pipe temperature is programmed

Figure B.3

Configuration 4



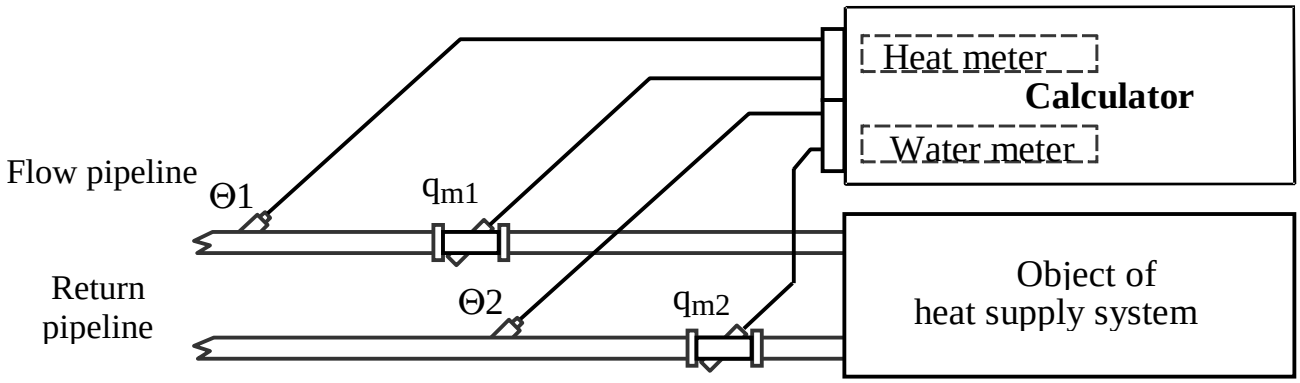
$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt + \int_t \left(q_{m1} - q_{m2}\right) \cdot (h_2 - h_{хв}) \cdot dt$$

Heat meter in an open district heating system without a cold water pipeline

(Cold water temperature Θ_{cold} is programmed)

Figure B.4

Configuration 5



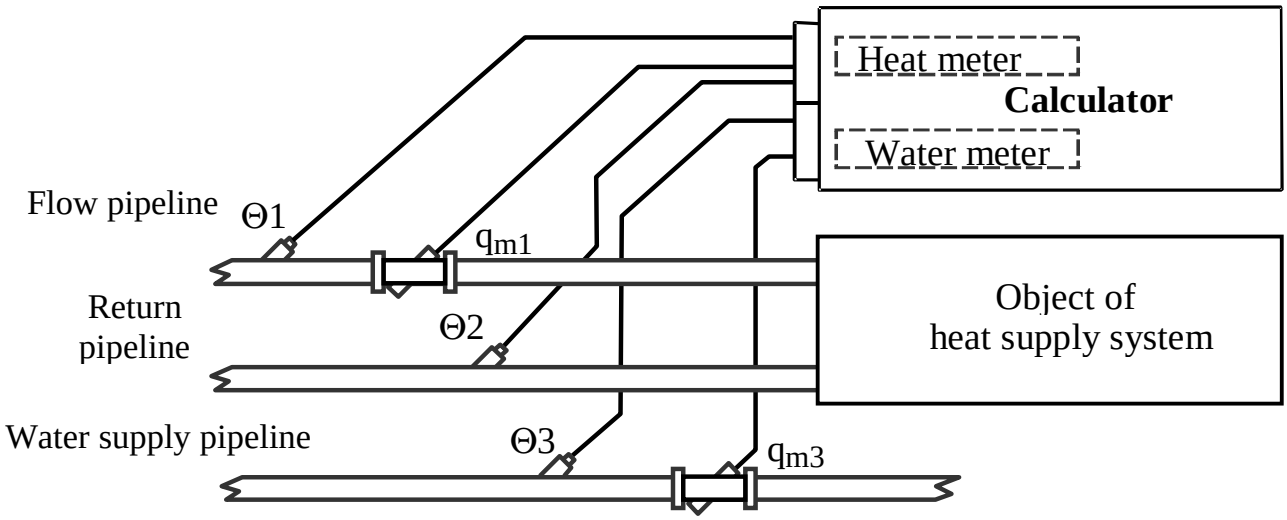
$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system with a control water meter on the return pipeline

(Basic function is heat quantity measurement, additional function is measurement of heat-conveying liquid volume in the return pipeline)

Figure B.5

Configuration 6



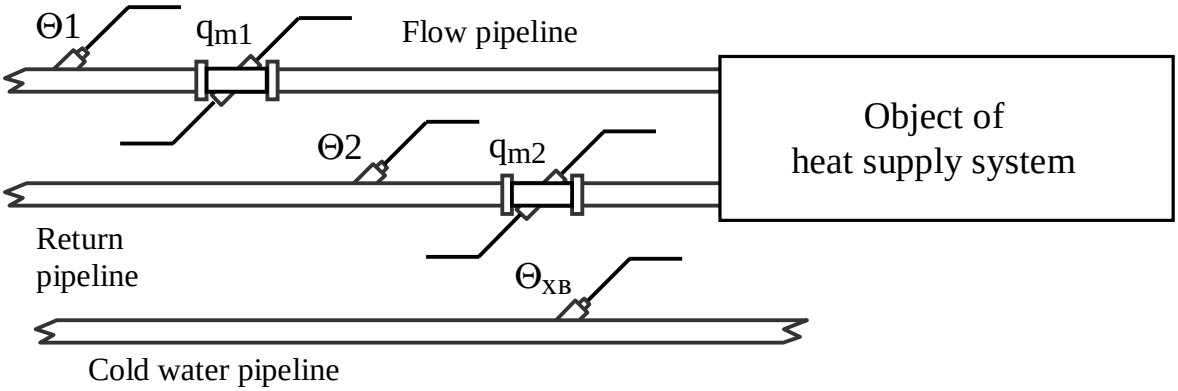
$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt$$

Heat meter in a closed district heating system and independent water meter

Basic function is heat quantity measurement, additional function is measurement of water in water supply pipeline.

Figure B.6

Configuration 7



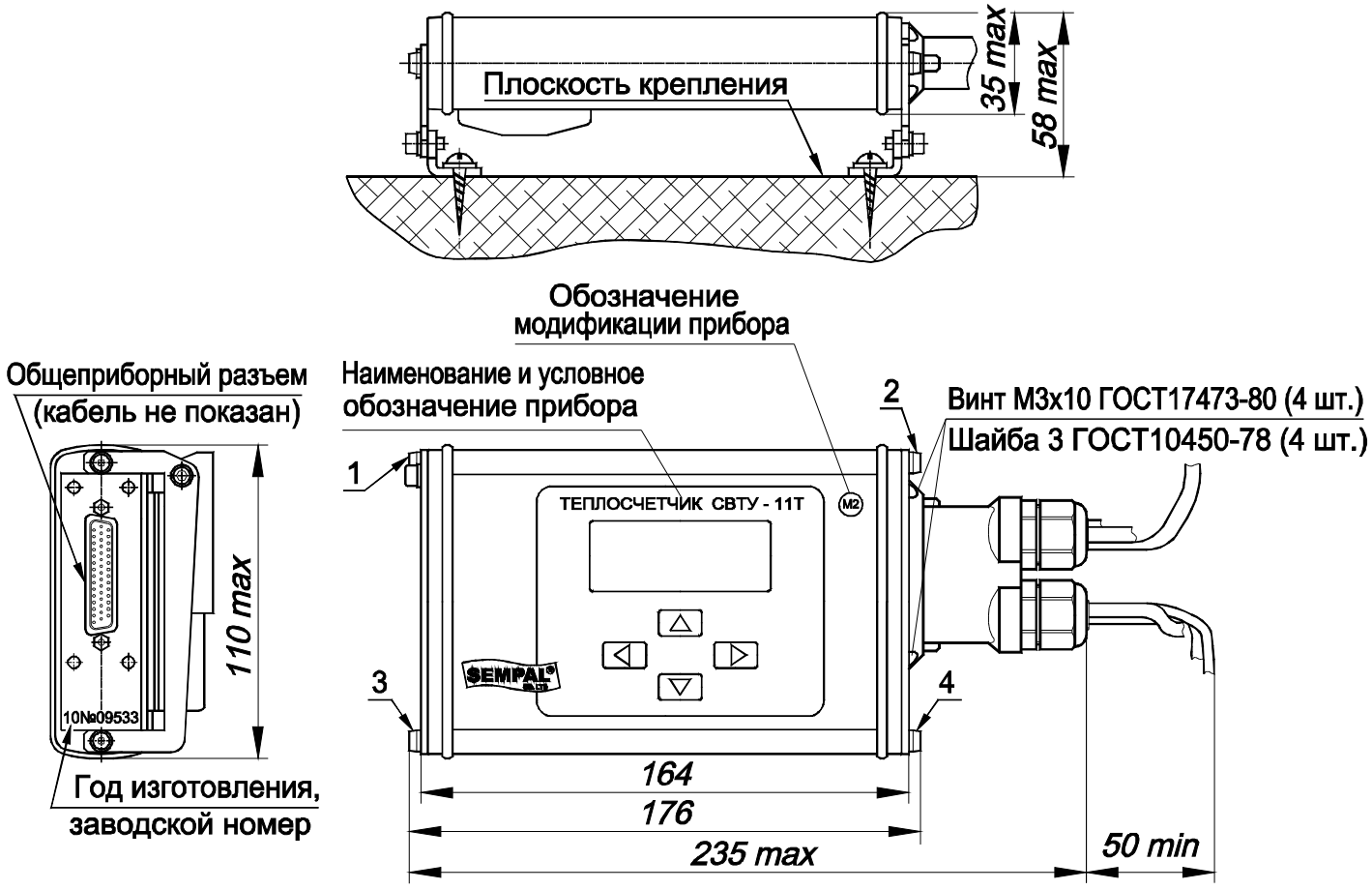
$$Q = \int_t q_{m1} \cdot (h_1 - h_2) \cdot dt + \int_t \left(q_{m1} - q_{m2}\right) \cdot (h_2 - h_{хв}) \cdot dt$$

Heat meter in an open district heating system with cold water supply pipeline

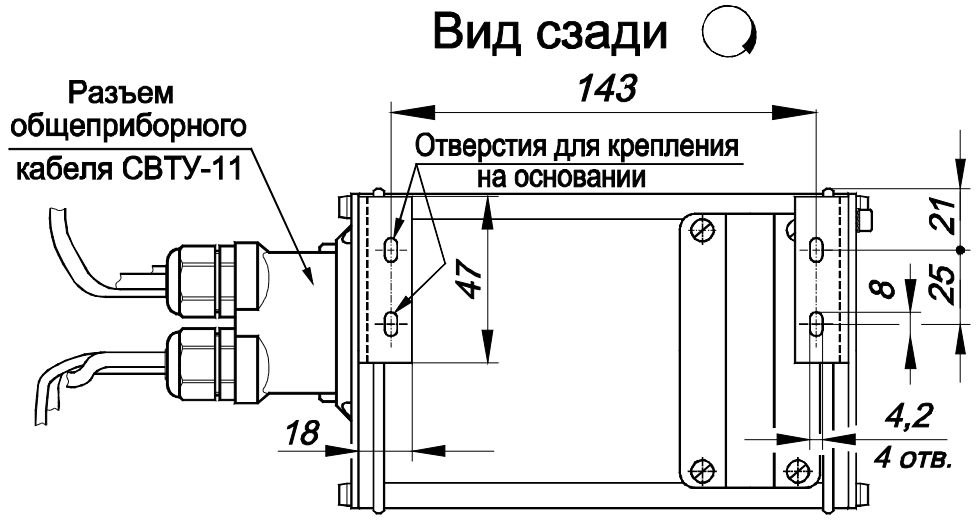
(Basic function is heat quantity measurement, cold water temperature is measured)

Figure B.7

Appendix C
Overall and connecting dimensions of calculator



Цифрами обозначены места для пломбирования:
1, 2 - места пломбирования изготовителем
3, 4 - места пломбирования на объекте (в т. ч. навесными пломбами)

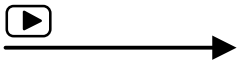


Appendix D
Meter control menu

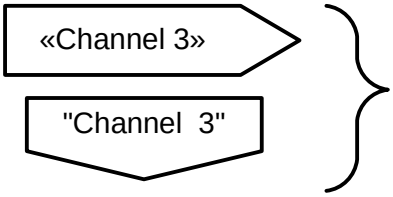
Reference designation

These buttons have the following functions:

▶ - «Right», ▲ - «Up», ▼ - «Down», ◀ - «Left»



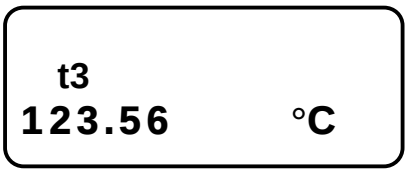
Move to next item if corresponding button has been pressed («Right» in the case)



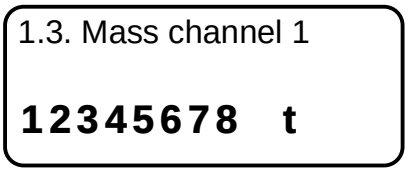
See continuation on the next page with corresponding title

Menu item denoted as (★) are indicated only for corresponding meter configuration.

Indication of menu item



Indicator in basic work mode.
The type of parameter and its dimension are displayed.



Indicator in menu item select mode.
Top line shows number of menu item and its name.
Bottom line can be used to display value of indicated parameter.

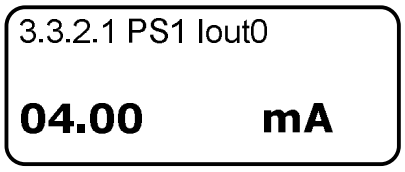
Editing of parameter can be done in three following steps:
- indication of parameter current value;
- editing the parameter. To start editing press “Right” button;
- indication of the result after ending of editing process.

After pressing the button “Right” edited symbol begins to blink.

There are two editing modes:

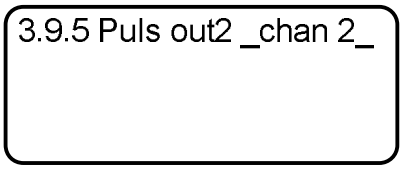
- editing of digital value;

- select an item from the list.



Editing of digital value

Edited digit blinks. Change of digit is provided by buttons “Up” and “Down”. Move to the next digit is provided by button “Right”. After reaching the last right digit the cursor moves to the first digit. Ending of editing occurs at pressing “Left” button. After that blinking is stopped and saved parameter value is displayed. If number with floating point are edited the final number may differ from entered number on one lower order bit. It can be explained by way of internal data representation.



Selection of the variant

Selecting menu item for change of parameter from the list of available values in the top row (right side) the current parameter value put into symbols “_” is indicated. After pressing “Right” button these symbols are changed to «▸ ◂» what means the beginning of editing. Change of parameter value is provided by “Up” and “Down” buttons. End of editing is occurred by “Left” button. After that entered value is displayed.

If parameter shouldn’t be edited (for example, “Enter” button has been pressed by mistake) editing can be interrupted and parameter would be in initial condition. For this purpose “Right” and “Left” buttons should be pressed simultaneously.

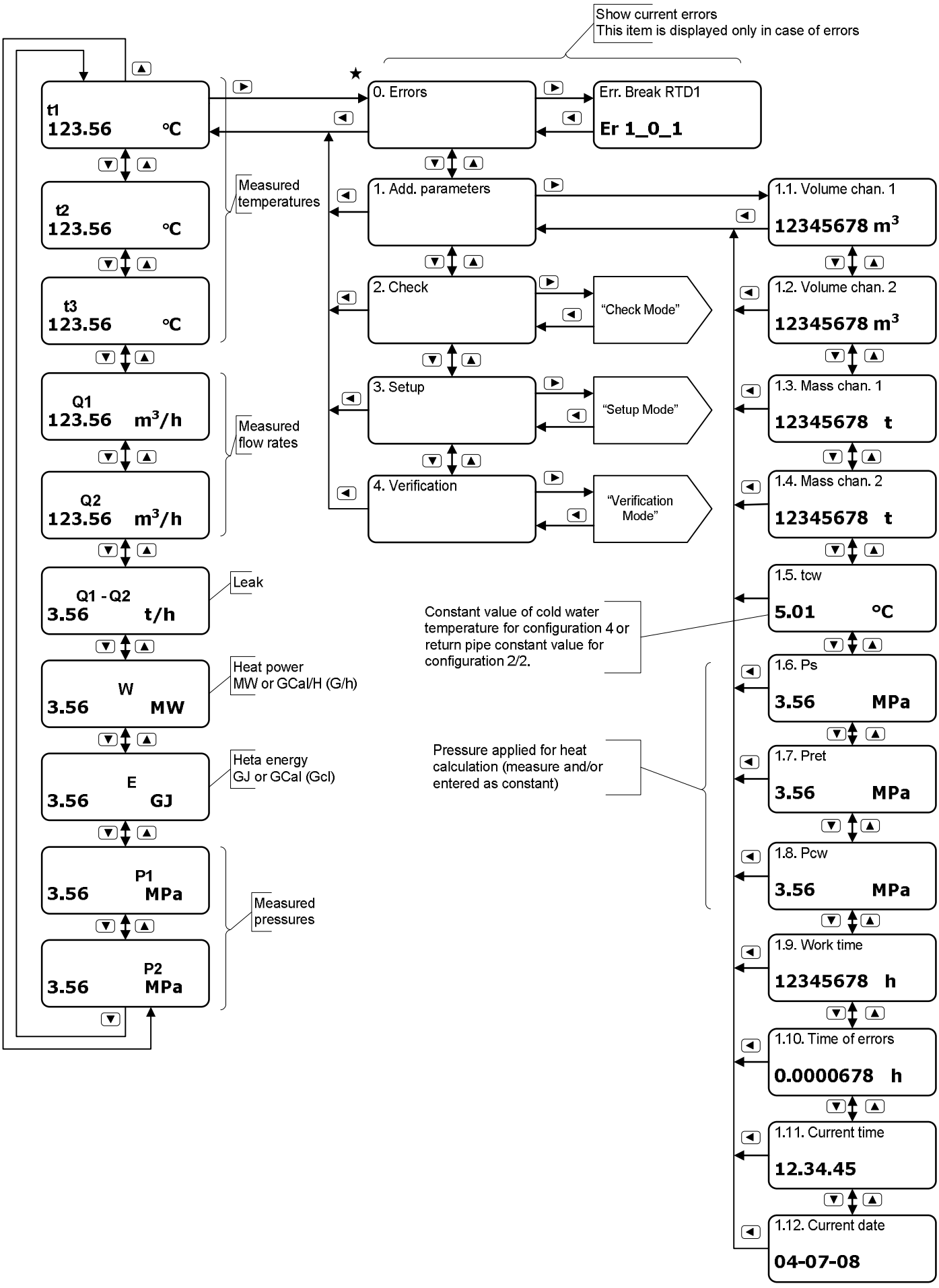
Notes:

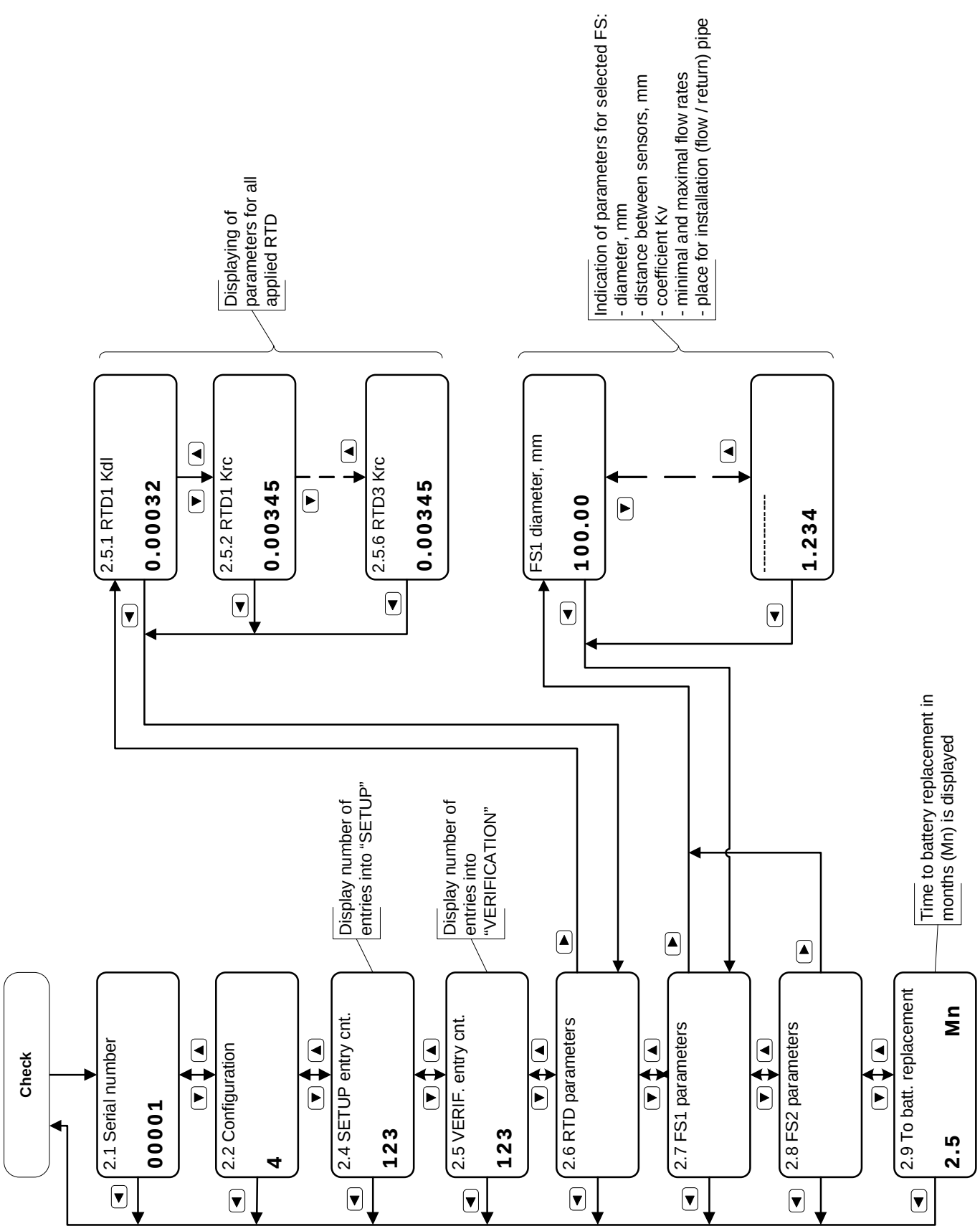
1. Holding any button for more than 0.5 sec will result in autorepeat of that button with the rate of 3 times per second.

If there was no pressing buttons in 2 min, the meter switches from selection mode or password entry to “Indication of main parameters” mode.

2. If entered an invalid parameter, the meter displays an error message. Pressing any button clear error message and returns to previous menu.

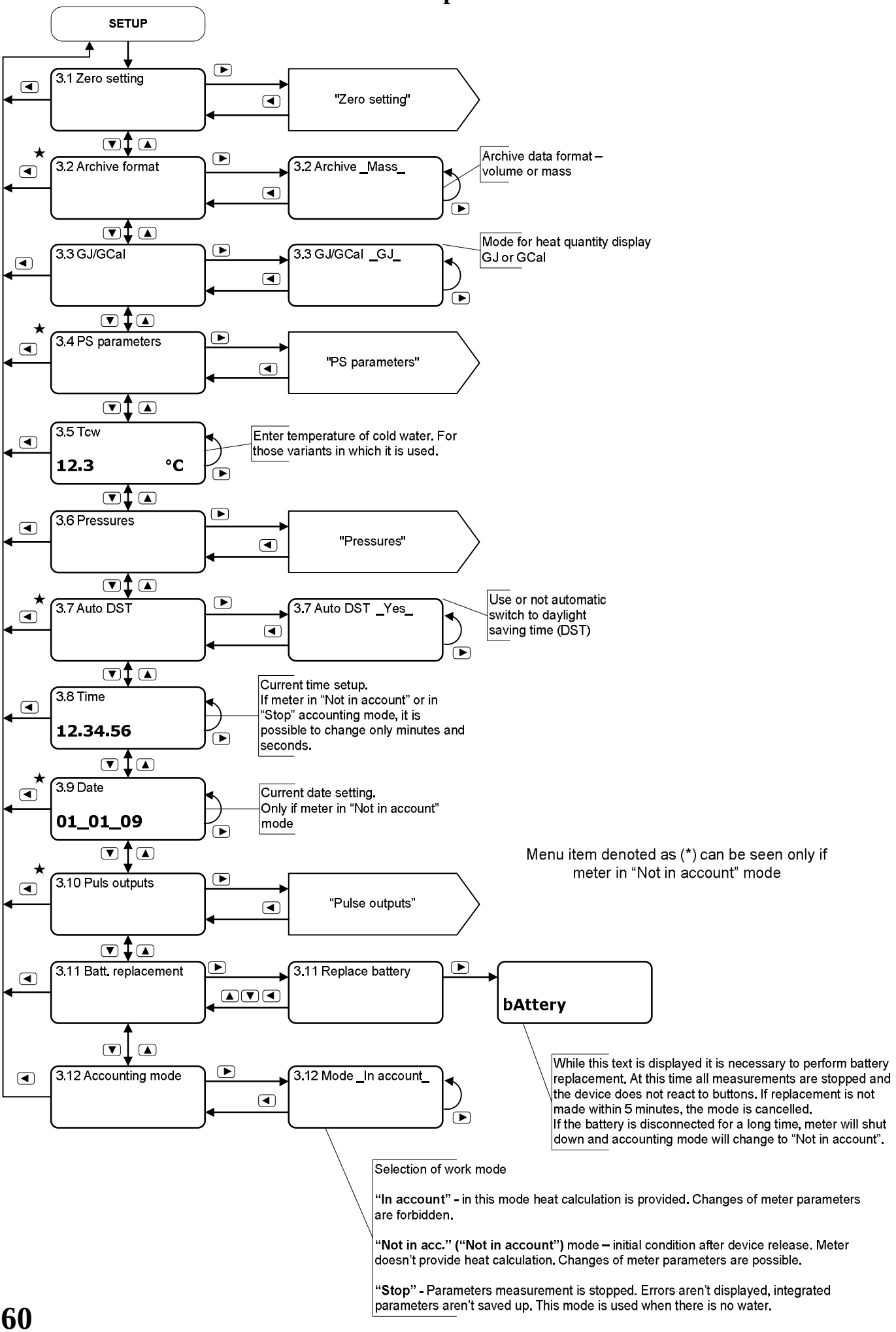
‘Indication of main parameters’ mode



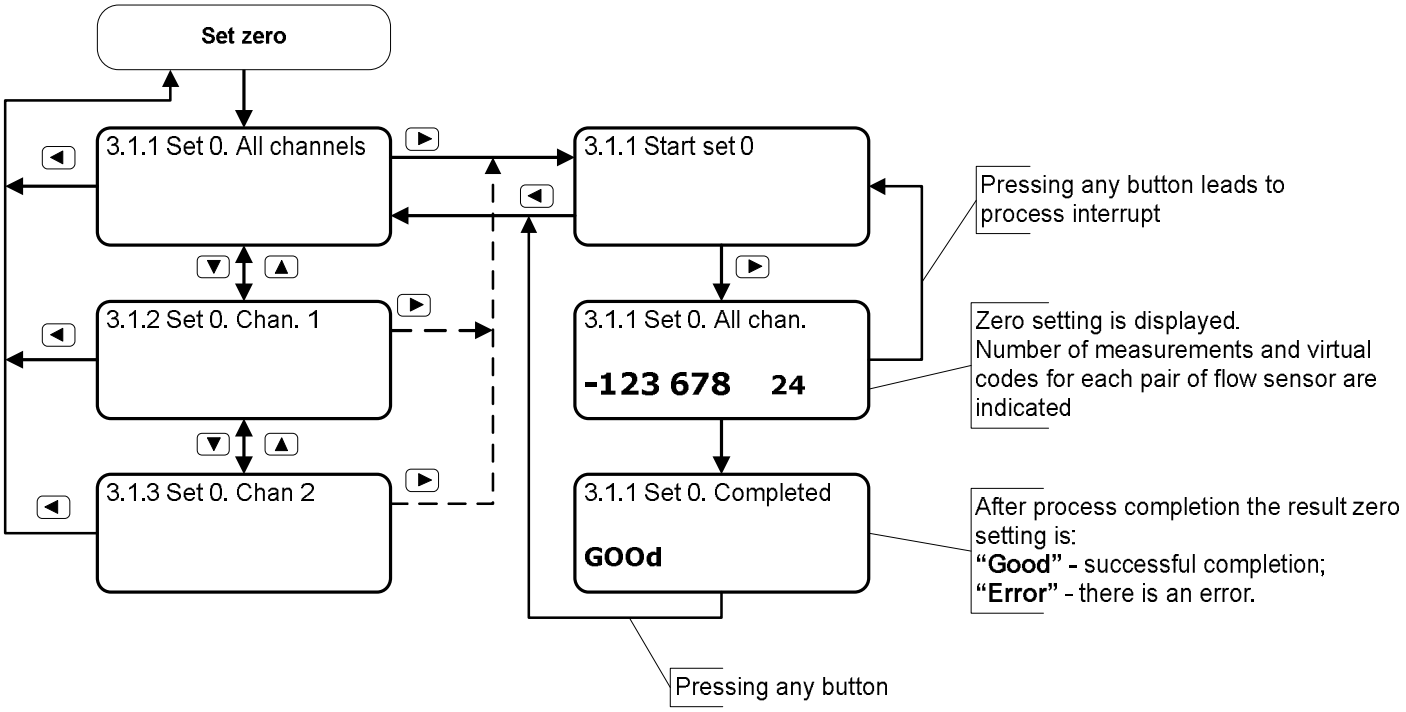

Check
2.1 Serial number
00001
2.2 Configuration
4
2.4 SETUP entry cnt.
123
Display number of entries into “SETUP”
2.5 VERIF. entry cnt.
123
Display number of entries into “VERIFICATION”
2.6 RTD parameters
2.7 FS1 parameters
2.8 FS2 parameters
2.9 To batt. replacement
2.5 Mn
Time to battery replacement in months (Mn) is displayed
2.5.1 RTD1 Kdl
0.00032
2.5.2 RTD1 Krc
0.00345
2.5.6 RTD3 Krc
0.00345
Displaying of parameters for all applied RTD
FS1 diameter, mm
100.00

1.234
Indication of parameters for selected FS:
- diameter, mm
- distance between sensors, mm
- coefficient Kv
- minimal and maximal flow rates
- place for installation (flow / return) pipe

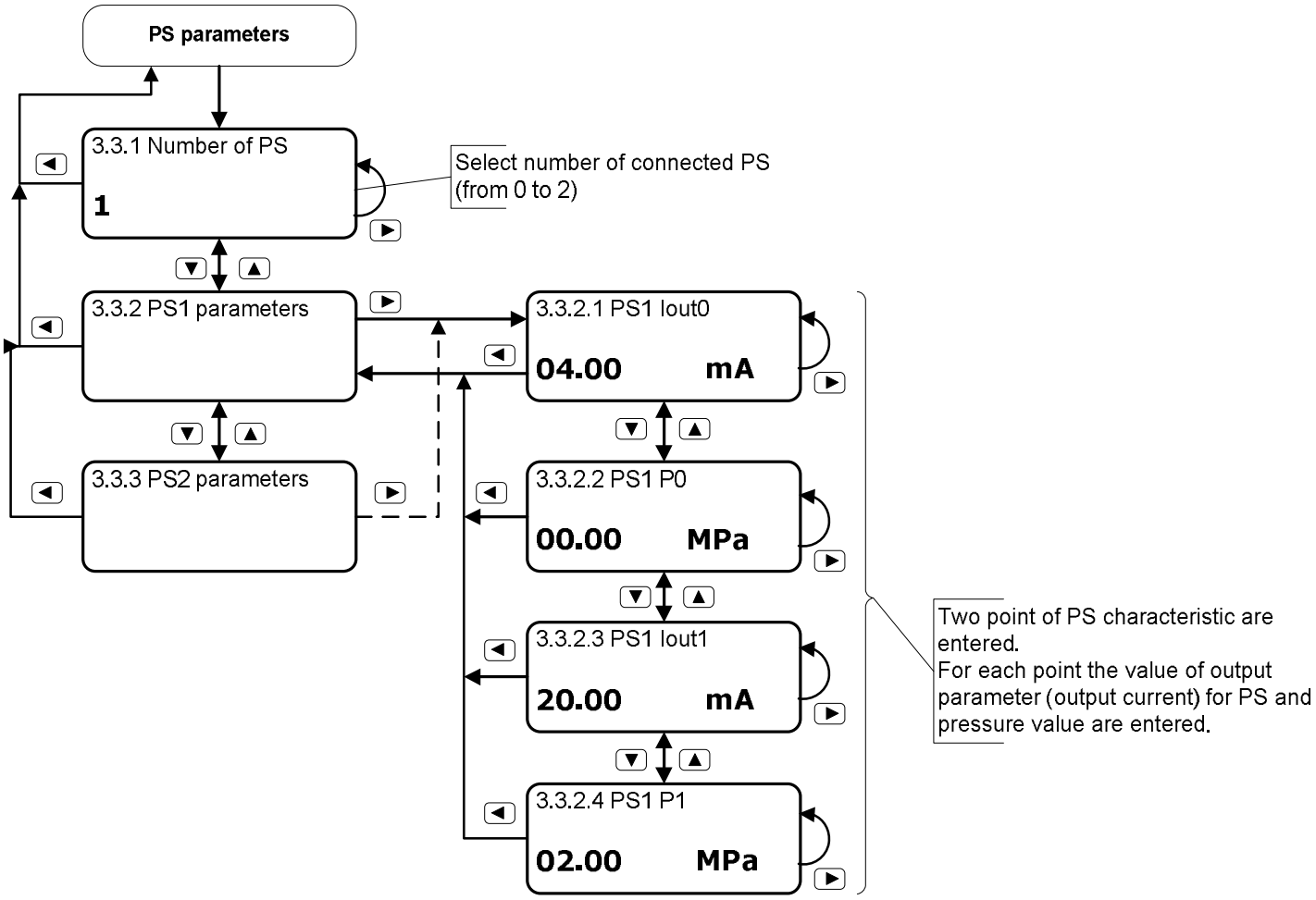
‘Setup’ mode


SETUP
3.1 Zero setting
"Zero setting"
3.2 Archive format
3.2 Archive _Mass_
Archive data format – volume or mass
3.3 GJ/GCal
3.3 GJ/GCal _GJ_
Mode for heat quantity display GJ or GCal
3.4 PS parameters
"PS parameters"
3.5 Tcw
12.3 °C
Enter temperature of cold water. For those variants in which it is used.
3.6 Pressures
"Pressures"
3.7 Auto DST
3.7 Auto DST _Yes_
Use or not automatic switch to daylight saving time (DST)
3.8 Time
12.34.56
Current time setup. If meter in “Not in account” or in “Stop” accounting mode, it is possible to change only minutes and seconds.
3.9 Date
01_01_09
Current date setting. Only if meter in “Not in account” mode
Menu item denoted as (*) can be seen only if meter in “Not in account” mode
3.10 Puls outputs
“Pulse outputs”
3.11 Batt. replacement
3.11 Replace battery
bAttery
While this text is displayed it is necessary to perform battery replacement. At this time all measurements are stopped and the device does not react to buttons. If replacement is not made within 5 minutes, the mode is cancelled.
If the battery is disconnected for a long time, meter will shut down and accounting mode will change to “Not in account”.
3.12 Accounting mode
3.12 Mode _In account_
Selection of work mode
“In account” - in this mode heat calculation is provided. Changes of meter parameters are forbidden.
“Not in acc.” (“Not in account”) mode – initial condition after device release. Meter doesn’t provide heat calculation. Changes of meter parameters are possible.
“Stop” - Parameters measurement is stopped. Errors aren’t displayed, integrated parameters aren’t saved up. This mode is used when there is no water.

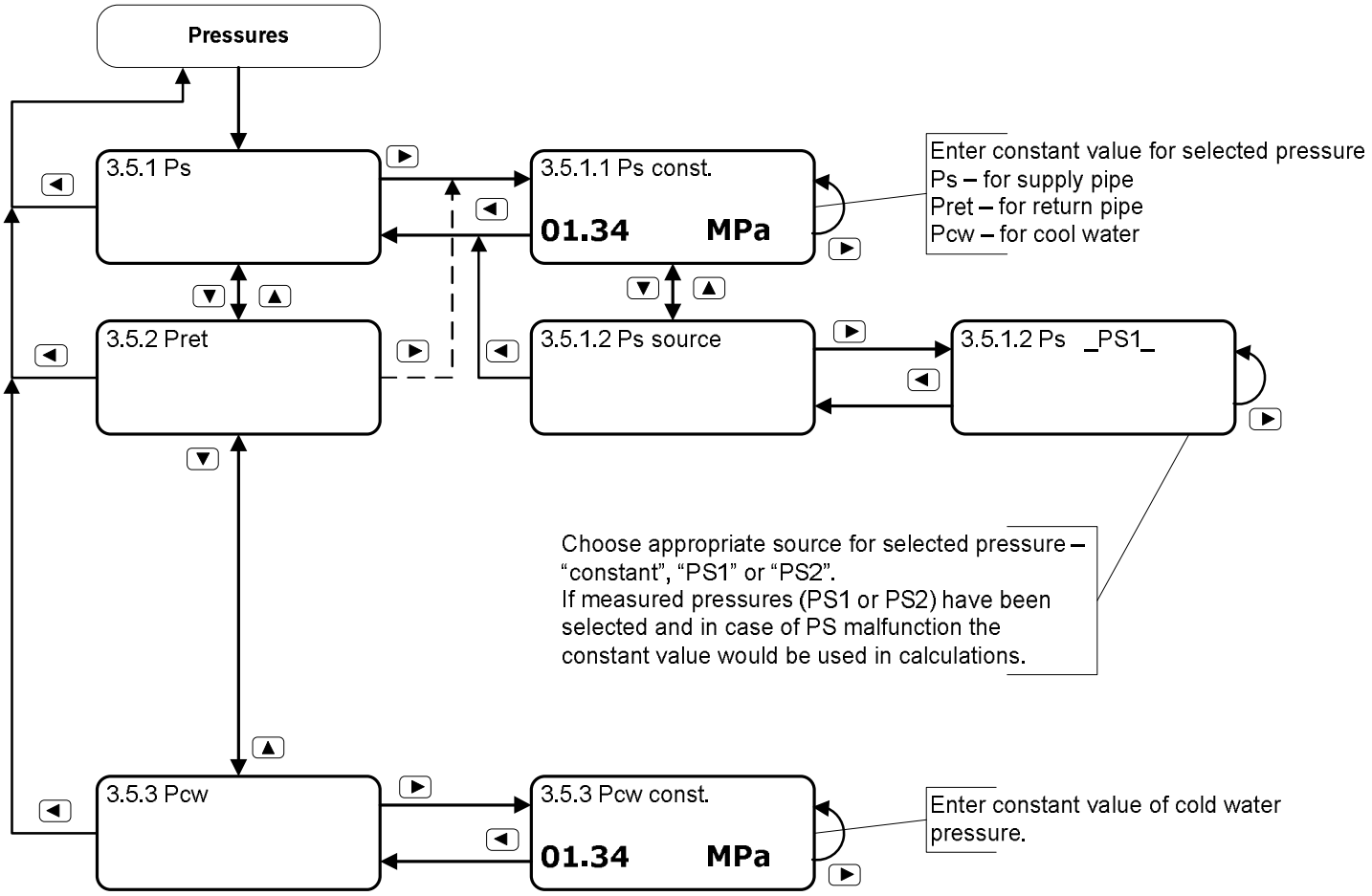
‘Setup / Set zero’ mode


Set zero
3.1.1 Set 0. All channels
3.1.2 Set 0. Chan. 1
3.1.3 Set 0. Chan 2
3.1.1 Start set 0
3.1.1 Set 0. All chan.
-123 678 24
3.1.1 Set 0. Completed
GOOd
Pressing any button leads to process interrupt
Zero setting is displayed.
Number of measurements and virtual codes for each pair of flow sensor are indicated
After process completion the result zero setting is:
“Good” - successful completion;
“Error” - there is an error.
Pressing any button

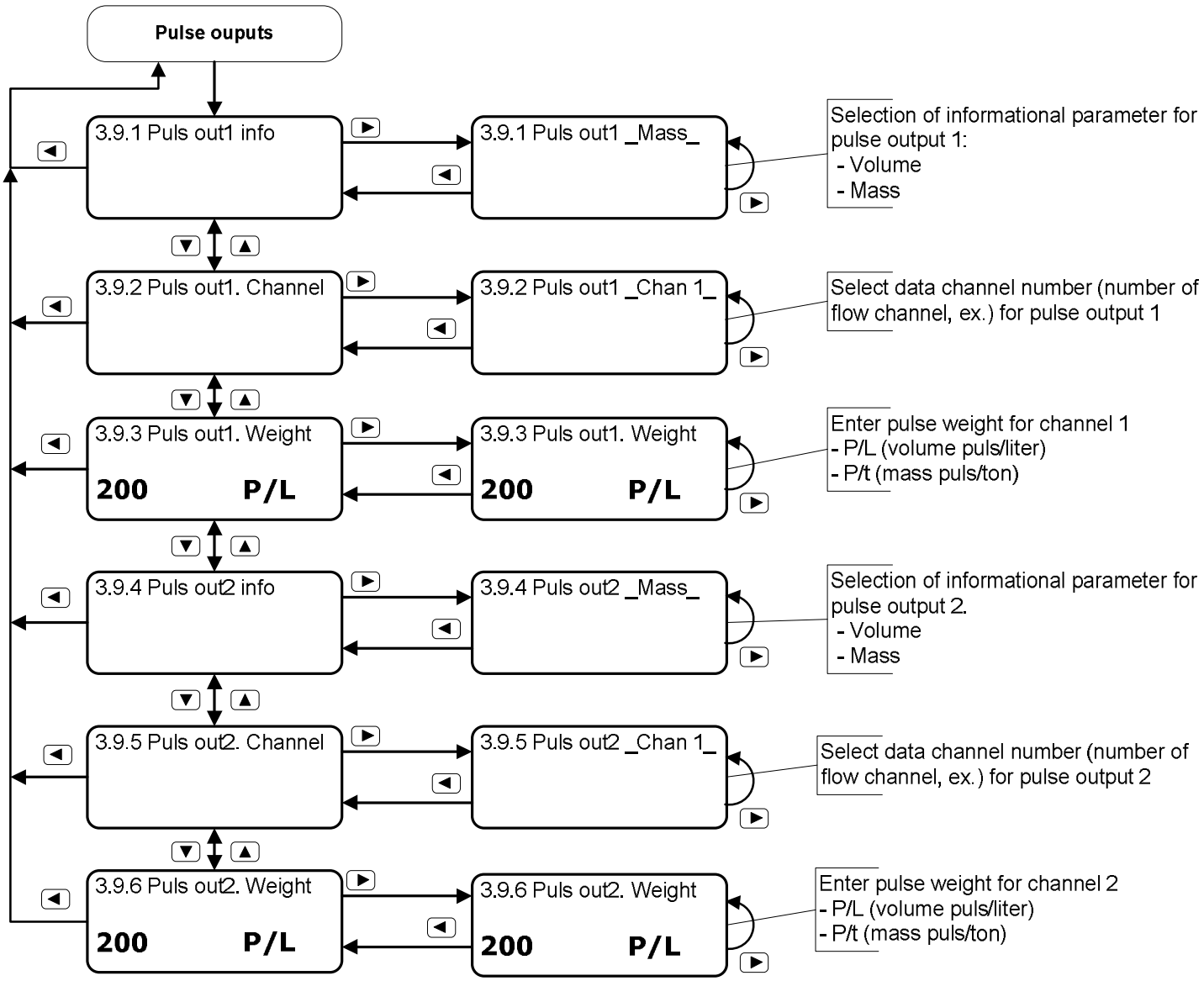
‘Setup / PS parameters’ mode


PS parameters
3.3.1 Number of PS
1
Select number of connected PS (from 0 to 2)
3.3.2 PS1 parameters
3.3.3 PS2 parameters
3.3.2.1 PS1 Iout0
04.00 mA
3.3.2.2 PS1 P0
00.00 MPa
3.3.2.3 PS1 Iout1
20.00 mA
3.3.2.4 PS1 P1
02.00 MPa
Two point of PS characteristic are entered.
For each point the value of output parameter (output current) for PS and pressure value are entered.

‘Setup/Pressures’ mode


Pressures
3.5.1 Ps
3.5.1.1 Ps const.
01.34 MPa
Enter constant value for selected pressure
Ps – for supply pipe
Pret – for return pipe
Pcw – for cool water
3.5.2 Pret
3.5.1.2 Ps source
3.5.1.2 Ps _PS1_
Choose appropriate source for selected pressure – “constant”, “PS1” or “PS2”.
If measured pressures (PS1 or PS2) have been selected and in case of PS malfunction the constant value would be used in calculations.
3.5.3 Pcw
3.5.3 Pcw const.
01.34 MPa
Enter constant value of cold water pressure.

’Setup / Pulse outputs’ mode


Pulse ouputs
3.9.1 Puls out1 info
3.9.1 Puls out1 _Mass_
Selection of informational parameter for pulse output 1:
- Volume
- Mass
3.9.2 Puls out1. Channel
3.9.2 Puls out1 _Chan 1_
Select data channel number (number of flow channel, ex.) for pulse output 1
3.9.3 Puls out1. Weight
200 P/L
3.9.3 Puls out1. Weight
200 P/L
Enter pulse weight for channel 1
- P/L (volume puls/liter)
- P/t (mass puls/ton)
3.9.4 Puls out2 info
3.9.4 Puls out2 _Mass_
Selection of informational parameter for pulse output 2.
- Volume
- Mass
3.9.5 Puls out2. Channel
3.9.5 Puls out2 _Chan 1_
Select data channel number (number of flow channel, ex.) for pulse output 2
3.9.6 Puls out2. Weight
200 P/L
3.9.6 Puls out2. Weight
200 P/L
Enter pulse weight for channel 2
- P/L (volume puls/liter)
- P/t (mass puls/ton)

Appendix E

Examples of reports, creating by “Sempal Device Manager” software

Hourly report example

Hourly parameters on 29/06/2010. Meter # 00050. Configuration 7. page 1 of 1

Hour	Twork h	Temperature, °C			Flow rate, m3			Heat, GCal	Pressure, kgf/cm2			Terr, h	Errors type	Notes	Temperature, °C		
		ts	tret	tcw	V1	V2	dV		Ps	Pret	Pcw				t1	t2	t3
08	0.27	50.96	46.14	24.93	2.560	1.779	0.780	0.02974	5.10	4.08	1.02	0.00			50.96	46.14	24.93
09	1.00	51.24	46.19	24.47	9.762	7.152	2.609	0.10449	5.10	4.08	1.02	0.00			51.24	46.19	24.47
10	1.00	57.83	49.08	25.10	9.599	7.920	1.679	0.12175	5.10	4.08	1.02	0.00			57.83	49.08	25.10
11	1.00	61.05	53.46	25.76	9.534	8.350	1.184	0.10264	5.10	4.08	1.02	0.00			61.05	53.46	25.76
12	1.00	61.62	54.06	25.75	9.555	8.299	1.256	0.10512	5.10	4.08	1.02	0.00			61.62	54.06	25.75
13	1.00	62.28	54.64	25.76	9.901	8.157	1.744	0.12302	5.10	4.08	1.02	0.00			62.28	54.64	25.76
14	1.00	62.87	55.21	25.79	9.840	8.361	1.479	0.11601	5.10	4.08	1.02	0.00			62.87	55.21	25.79
15	1.00	63.05	55.37	25.83	9.771	8.388	1.383	0.11296	5.10	4.08	1.02	0.00			63.05	55.37	25.83
16	1.00	62.89	55.37	25.87	9.687	8.561	1.126	0.10326	5.10	4.08	1.02	0.00			62.89	55.37	25.87
17	1.00	62.41	55.18	25.84	9.661	8.272	1.389	0.10784	5.10	4.08	1.02	0.00			62.41	55.18	25.84
18	1.00	61.65	54.48	25.64	9.682	7.690	1.992	0.12402	5.10	4.08	1.02	0.00			61.65	54.48	25.64
19	1.00	61.25	54.11	25.20	9.666	7.801	1.865	0.12017	5.10	4.08	1.02	0.00			61.25	54.11	25.20
20	1.00	61.01	53.71	24.04	9.437	7.623	1.814	0.11983	5.10	4.08	1.02	0.00			61.01	53.71	24.04
21	1.00	61.00	53.44	23.43	9.559	6.737	2.822	0.15382	5.10	4.08	1.02	0.00			61.00	53.44	23.43
22	1.00	61.18	53.42	22.79	9.440	6.987	2.453	0.14512	5.10	4.08	1.02	0.00			61.18	53.42	22.79
23	1.00	61.60	54.00	23.22	9.718	7.642	2.076	0.13479	5.10	4.08	1.02	0.00			61.60	54.00	23.22
	15.25	60.69	53.41	24.96	147.371	119.721	27.650	1.82458	5.10	4.08	1.02	0.00			60.69	53.41	24.96

Daily report example

BILL of
heat consuming from **29/06/2010** to **29/06/2010**

page 1 of 1

Organization: _____

Address: _____

Account: _____

Meter: SVTU-11 S/N 00050. Configuration 7.

Conventional data:

heating: _____ **ventilation:** _____

Date	Twork h	Temperature, °C			Flow rate, m3			Heat, GCal	Pressure, kgf/cm2			Terr, h	Errors type	Temperature, °C		
		ts	trev	tcw	V1	V2	dV		Ps	Prev	Pcw			t1	t2	t3
29/06/2010	15.25	60.69	53.41	24.96	147.371	119.721	27.650	1.82458	5.10	4.08	1.02	0.00		60.69	53.41	24.96
	15.25	60.69	53.41	24.96	147.371	119.721	27.650	1.82458	5.10	4.08	1.02	0.00		60.69	53.41	24.96

Measurement system used in report (SI or SGS) chosen by user in “Setup” mode menu.

Errors report example

Hourly data of errors for meter S/N 54 from 15/01/2010 to 28/01/2010. page 1 of 1

Date	Error code and duration in hour
15/01/2010	
18:00	1_1_1 = 0.12 1_1_2 = 0.12 3_1_1 = 0.12 3_1_2 = 0.12
16/01/2010	
10:00	1_1_1 = 0.49 1_1_2 = 0.49 3_1_1 = 0.51 3_1_2 = 0.51
11:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
12:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
13:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
14:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
15:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
16:00	1_1_1 = 1.00 1_1_2 = 1.00 3_1_1 = 1.00 3_1_2 = 1.00
17:00	1_1_1 = 0.63 1_1_2 = 0.63 3_1_1 = 0.62 3_1_2 = 0.62

Journal report example

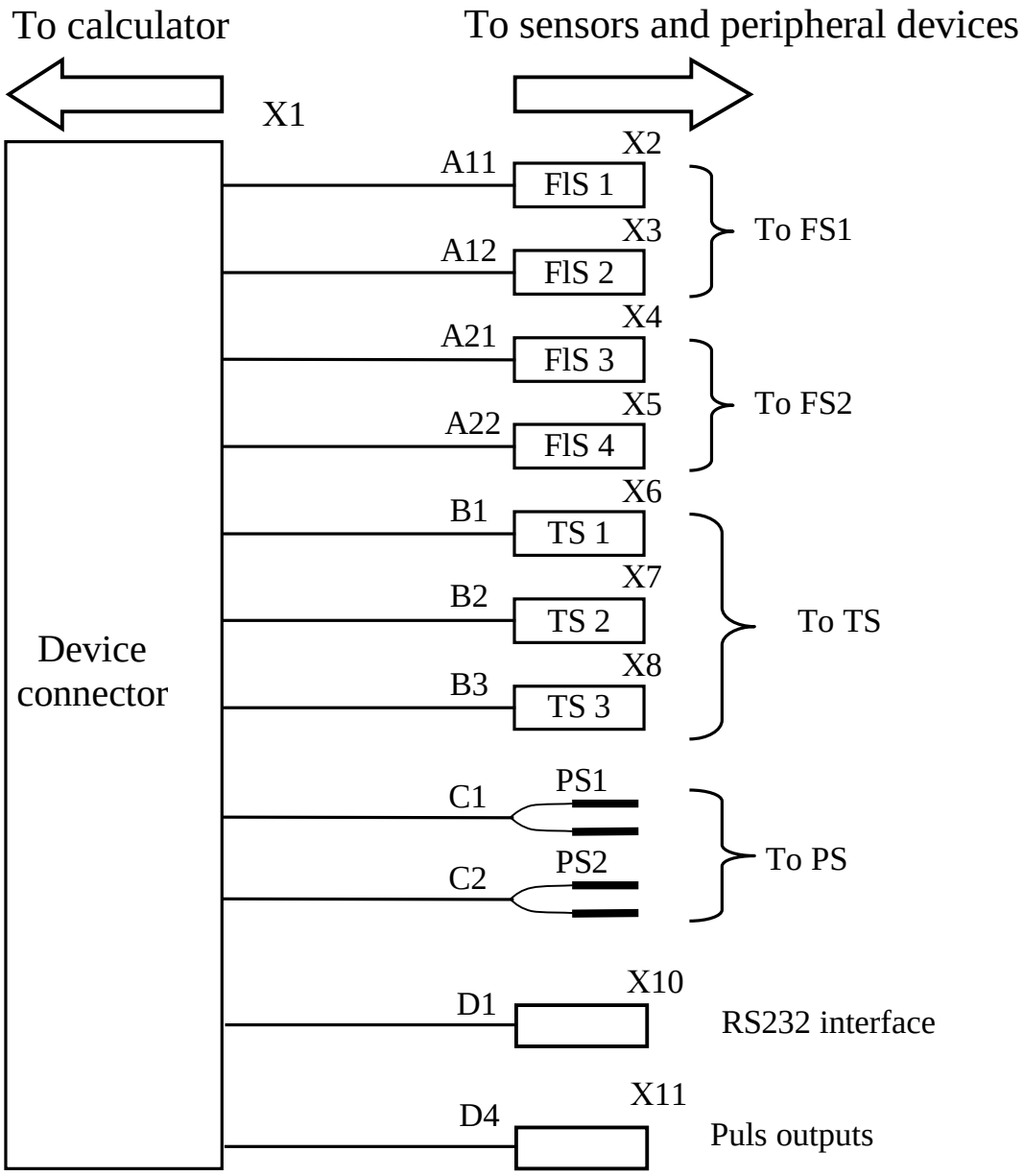
Event journal for meter S/N 00050

с 29/06/2010 по 29/06/2010

Pos.	Date	Journal record
1	29/06/2010 07:44:09	Exit from "SETUP" mode
2	29/06/2010 07:43:45	End of reset
3	29/06/2010 07:43:45	Data clearing …
4	29/06/2010 07:42:20	3.2.Archive _Volume_
5	29/06/2010 07:42:02	"SETUP" mode enter

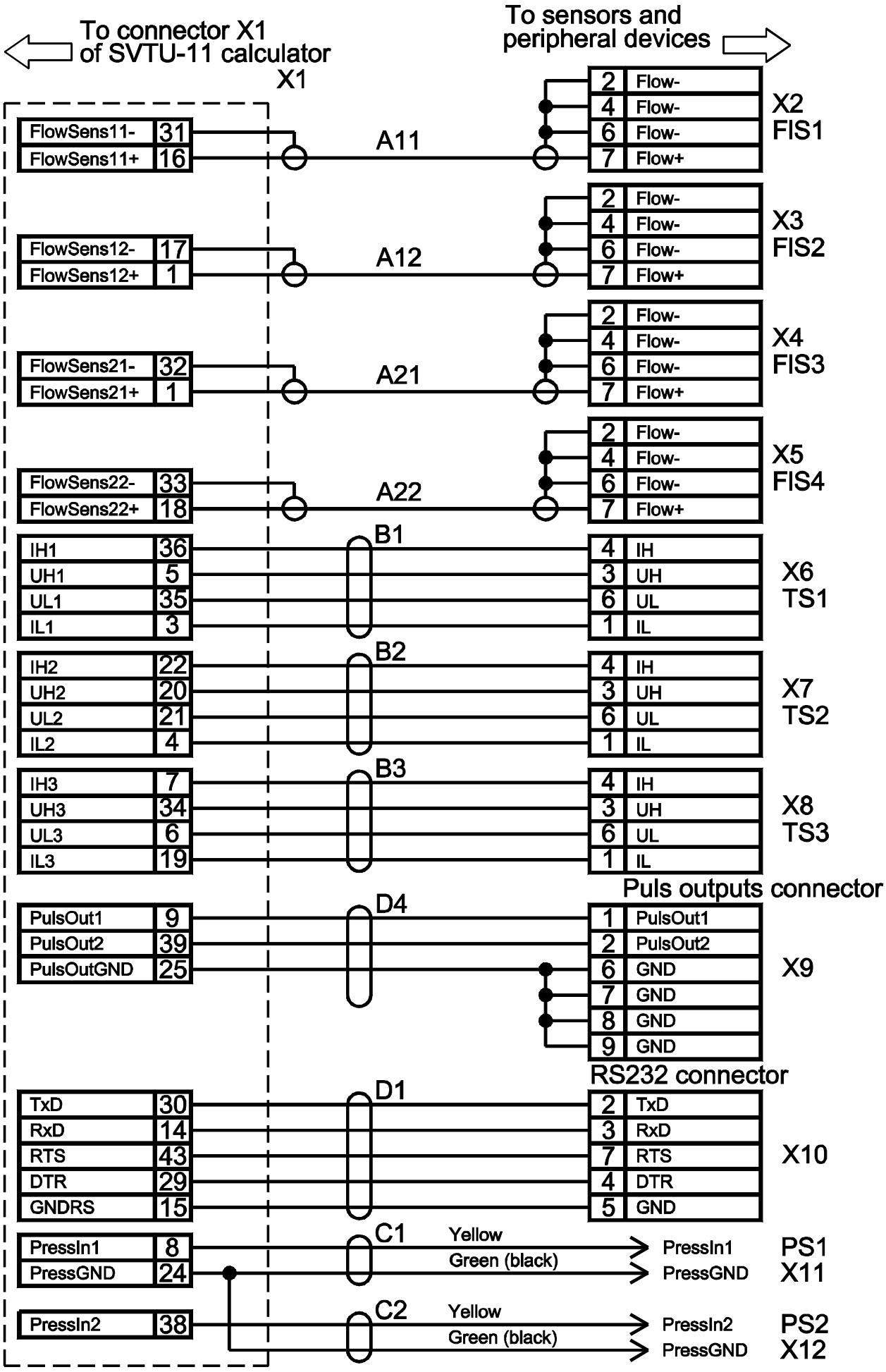
Appendix F

Schematic of device cable

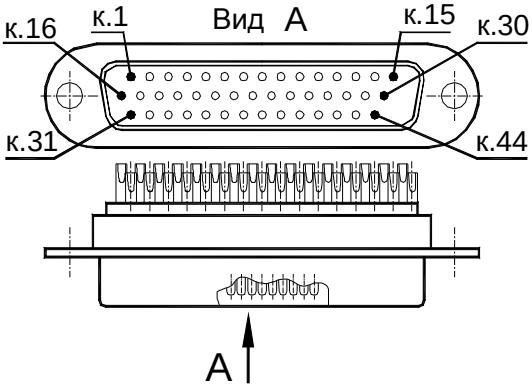


The notice. Enumeration of connection lines according to tables 9.4 and 9.5.

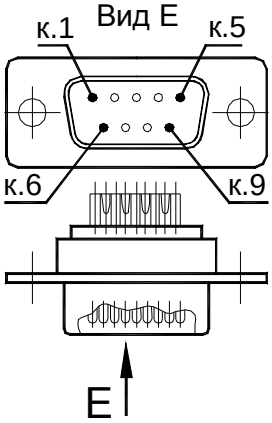
Basic circuit for device cable



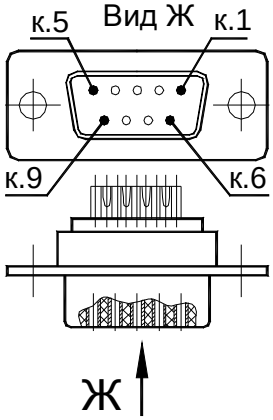
вилки DHS-44M
(общеприборного разъема)



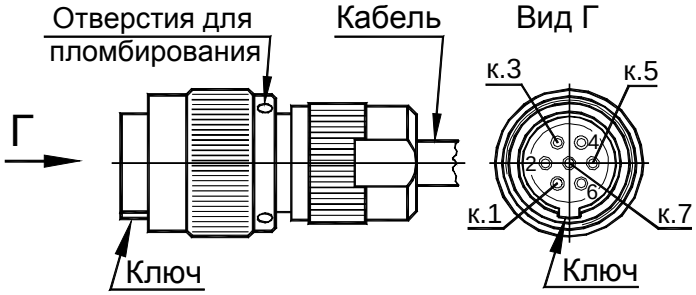
вилки DB-9M



розетки DB-9F



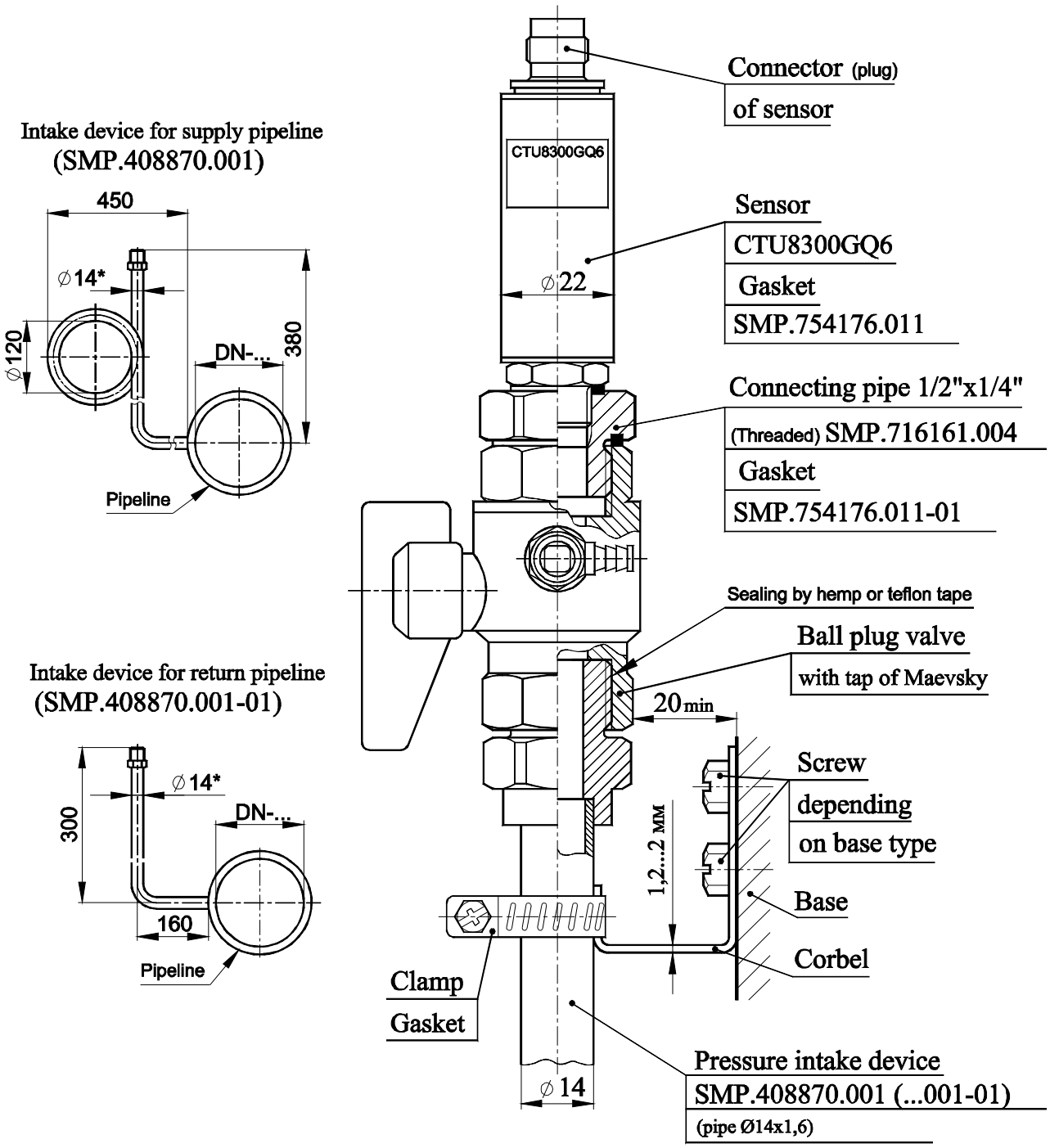
кабельной розетки УЗНЦ 05-7
(используется в общеприборном кабеле)



Appendix K

The scheme of pressure sensor mounting

Recommended mounting scheme for pressure sensor
CTU8300GQ6 (as example) and dimensions of pressure takeoff devices

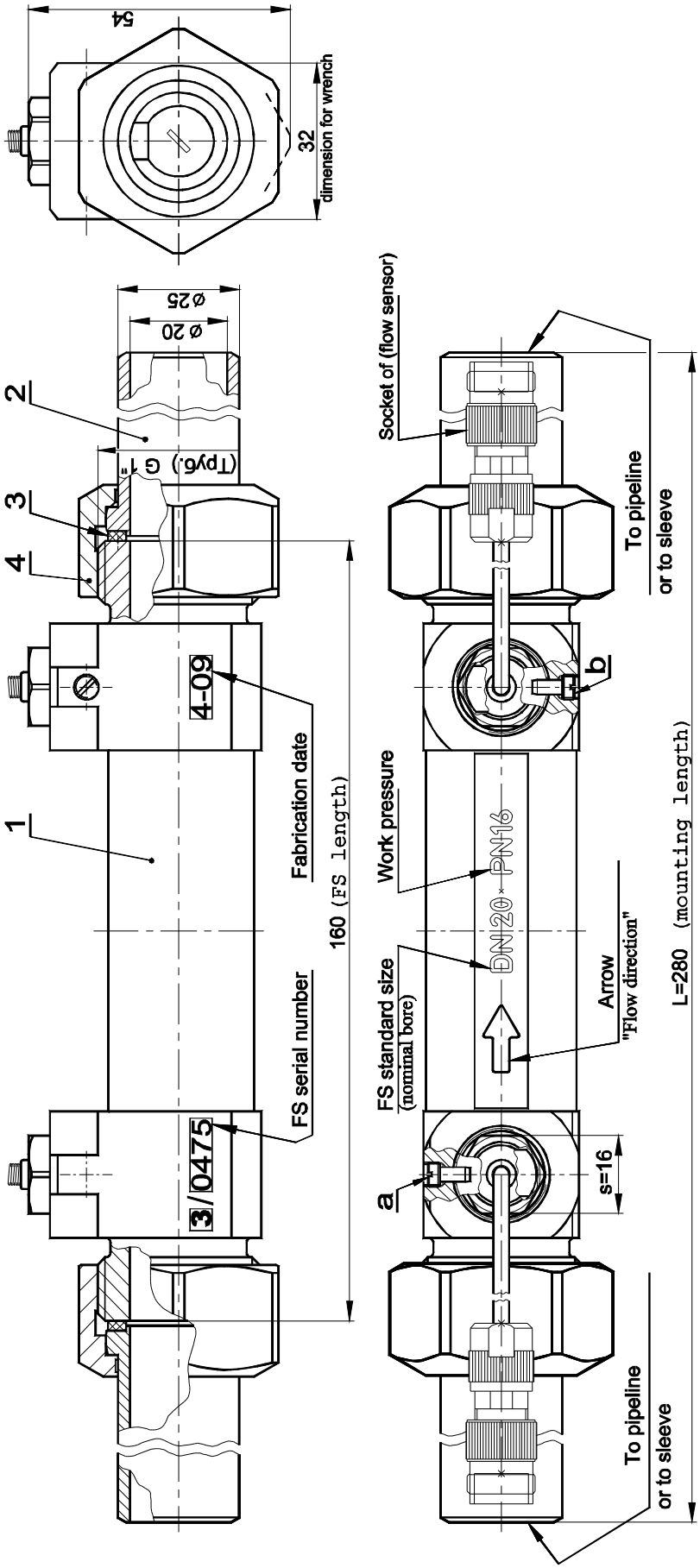


1 The sensor is mounted in strictly vertical position (see figure).

2 If water characteristics don't meet to technical requirements, then to prevent polymerizing, crystallizing and pollution on a sensor it is necessary to mount a membranous divider with application of dividing organosilicon liquids #2.

3 The length of tubes should provide cooling of water up to 70 °C.

Overall and fitting dimensions of FS DN-20

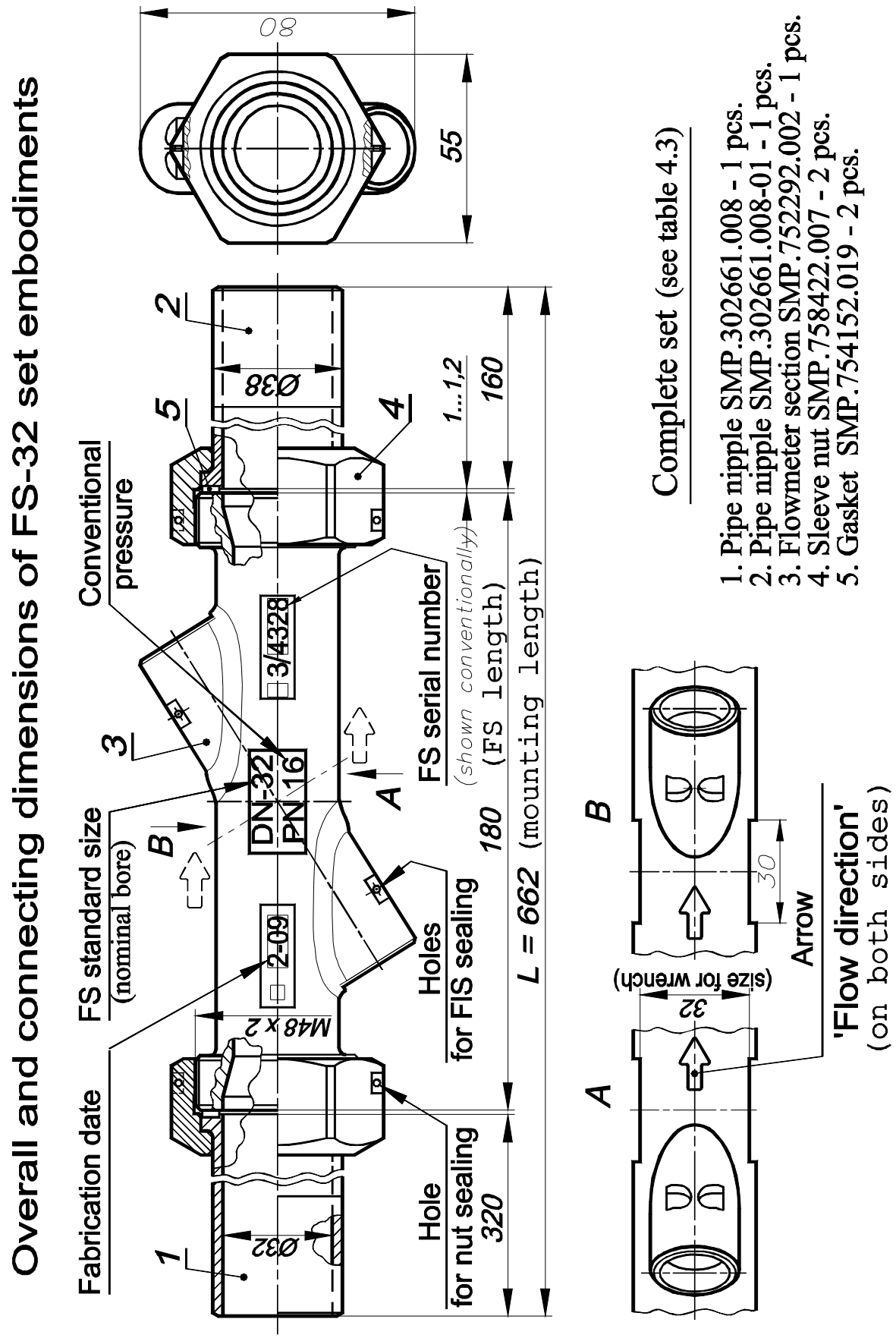


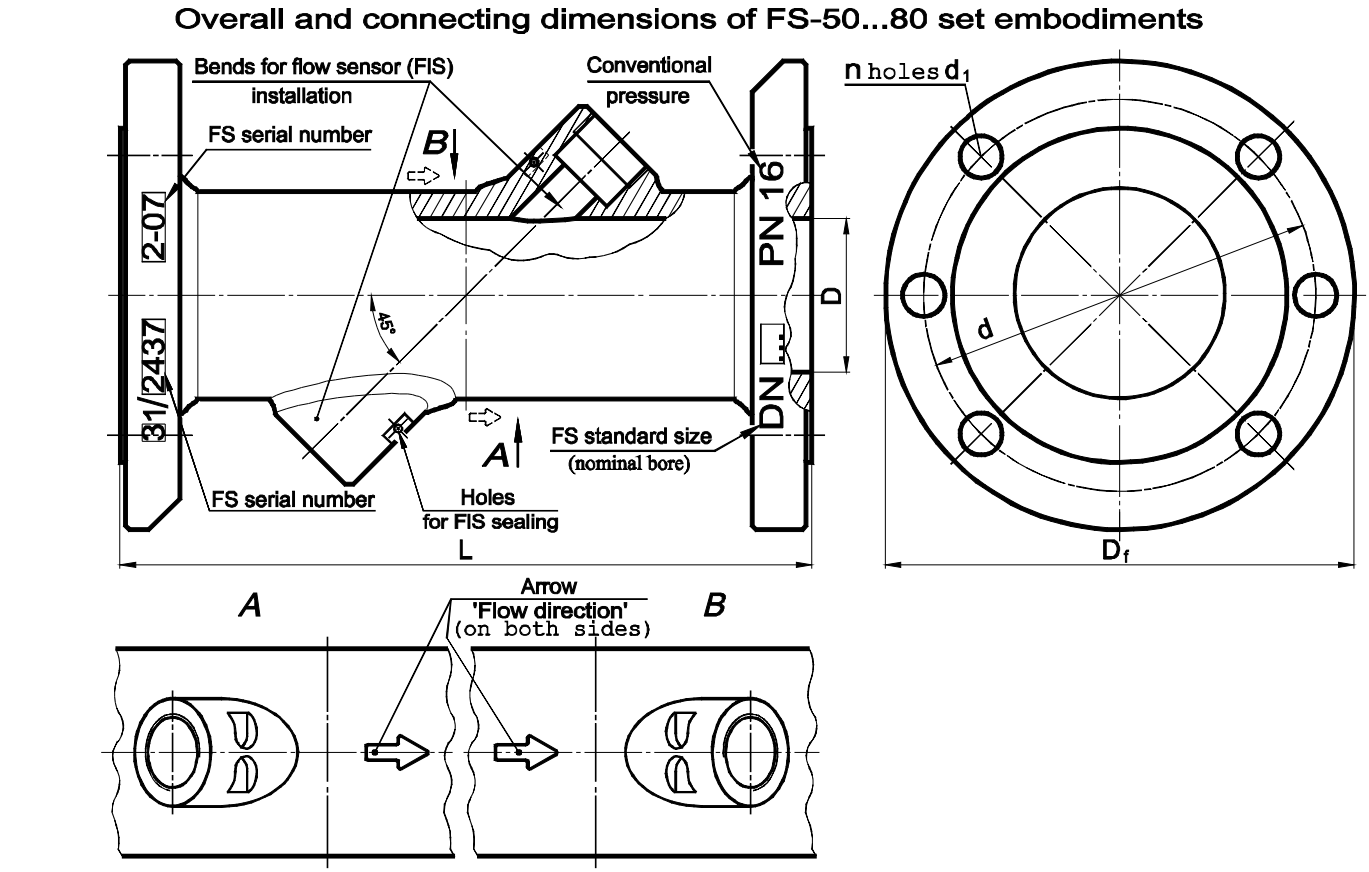
Notes

1 **a , b** - places of possible stamping FIS by maker
2 Serial number and date of manufacturing are shown conventionally
3 Planes for wrench s=32 are for keeping in required position at installation

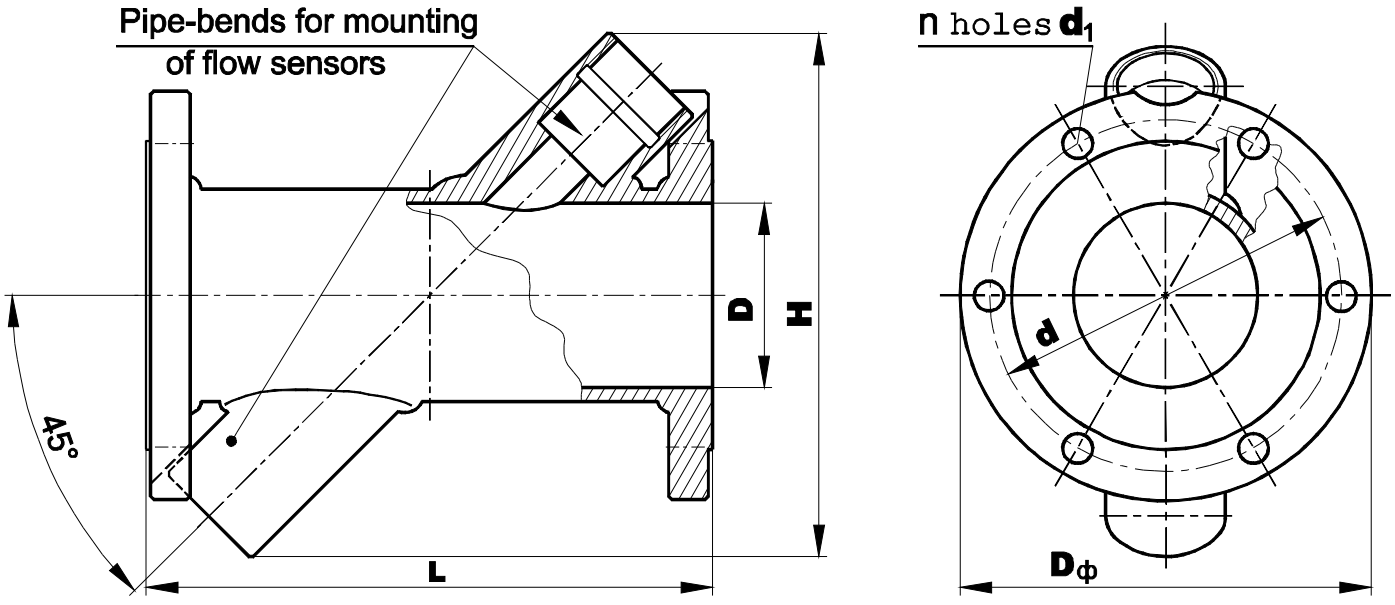
Complete set (see table 4.3)

1 Flow measuring section DN-20 SMP.723165.006 - 1 pcs.
(with flow sensors - 2pcs.).
2 Pipe nipple SMP.752291.001 - 2 pcs.
3 Fitting piece SMP.754152.013 - 2 pcs.
4 Sleeve nut SMP.758422.006 - 2 pcs.


Overall and connecting dimensions of FS-32 set embodiments
Fabrication date
FS standard size
(nominal bore)
Conventional
pressure
FS serial number
(shown conventionally)
Holes
for FIS sealing
Hole
for nut sealing
DN-32
PN 16
M48 x 2
Ø32
Ø38
□3/4328
□ 2-09
1...1,2
160
180
320
L = 662 (mounting length)
(FS length)
80
55
30
32
(size for wrench)
Arrow
'Flow direction'
(on both sides)
Complete set (see table 4.3)
1. Pipe nipple SMP.302661.008 - 1 pcs.
2. Pipe nipple SMP.302661.008-01 - 1 pcs.
3. Flowmeter section SMP.752292.002 - 1 pcs.
4. Sleeve nut SMP.758422.007 - 2 pcs.
5. Gasket SMP.754152.019 - 2 pcs.



FS of DN 50…80



FS of DN 100…150

Appendix M

How to set hydraulic zero

It is possible occurrence can be caused by difference in manufacturing and real conditions of setting zero.

This phenomenon appears as non-zero meter indications when the real flow velocity is equal to zero.

This action allows eliminating of a systematic measurement error from measuring results.

Device maintenance without zero setting or with incorrect zero setting can lead to significant flow measurement errors, especially in a range of low flow rates.

Zero setting should be carried out:

– at device commissioning;

– after mounting (dismantling) of flow sensors (FlS) during routine maintenance;

– after changing of order of cable connections to flow measurement section (FS);

– at inspection of flow measurement channel functionality.

Zero setting in each water meter channel is desirable to conduct at first out of pipe (on 'tapped' FS) and then (it is obligatory) on the object. If there is no possibility to cut off a water, zero setting out of pipe is a unique way for correct device commissioning. Thus it is necessary to provide repeated connection of flow measurement channels cables and FlS, which has been used during zero setting in laboratory conditions. Thus FlS should not be dismantled from 'tapped' FS.

1 Inspection of correctness for zero setting on 'tapped' FS:

1.1 Assemble a flow measurement section with technological tap at the end face, locate it vertically, fix flow sensors and completely fill FS with preliminary boiled or settled water. Clean end faces of flow sensors from remained air bubbles manually (by a finger or a brush) if they were appeared during filling of FS.

1.2 Connect flow sensors (FlS) and resistive temperature detectors (RTD) to corresponding cables.

1.3 No error messages concerning flow rate and temperature measurements.

1.4 Enter the mode 'Zero setting' and make setting on both channels simultaneously or separately. While setting, two groups of digits are displayed on the screen. The first one represents the hardware information about zero water velocity. This group is stored before following resetting. The second group shows number of zero velocity measurement cycles. For identical FS types these numbers of measurement cycles usually coincide. For different FS types they can be different, within the limits of 96 cycles, but do not exceed 120.

1.5 If zero setting has not been completed positively, it is necessary to check up serviceability of cables, quality of connections in sockets and then repeat the previous item.

2 For successful zero setting on an object it is necessary to provide**:**

– reliable water cutting off from both sides of flow measurement section by means of valves;

– qualitative installation and serviceability of flow sensors, temperature sensors and also device entrance cables;

– the level of electromagnetic interference created by surrounding equipment, should not exceed a permissible level for the meter.

Before hydraulic zero setting it is necessary to run the water meter in waterworks on the maximal water flow rate for half an hour, then to cut off a valve after flow measurement section, to cut off a valve before flow measurement section. Hydraulic zero setting can be conducted in a few minutes after water fluctuations in the tapped section will stop.

If value of the first group of digits, displayed on the meter indicator and registered by the meter as water zero velocity noticeably exceeds 500 or number of measurement cycles, then some obstacles are possible on tapped FS:

- air bubbles in FS;
- water leak through valves;
- significant level of external electromagnetic noise.